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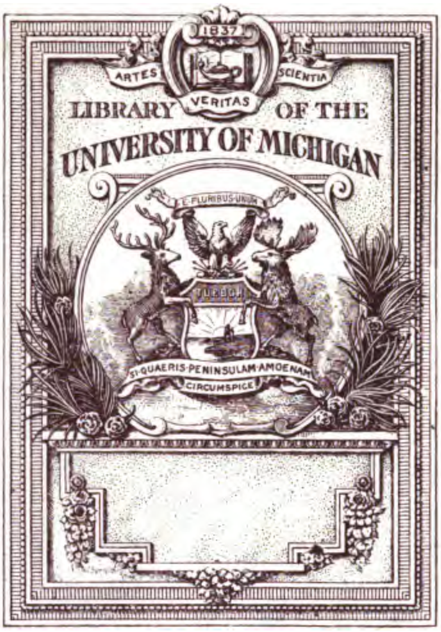

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Missouri State Board of Agriculture.

COMPLIMENTS OF

Geo. B. Ellis,

Secretary.

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Thirty-Eighth Annual Report

OF THE

MISSOURI

State Board of Agriculture

A Record of the Work for the Year 1905

ALSO VALUABLE INFORMATION ON BREEDING AND FEEDING LIVE STOCK, IMPROVING THE FERTILITY OF THE SOIL, GROWING CROPS, DAIRYING, AGRICULTURE AND LIVE STOCK STATISTICS, ETC.

PUBLISHED 1906.

THE HUGH STEPHENS PRINTING COMPANY
JEFFERSON CITY, MO.

Officers of State Board of Agriculture, 1906.

President—S. H. Prather, Tarkio.
Vice-President—S. W. Hudson, Buckner.
Secretary—Geo. B. Ellis, Columbia.
Assistant Secretary, Miss J. B. Rector, Columbia.
Crop Statistician—L. F. Childers, Columbia.
Treasurer—W. A. Bright, Columbia.
State Veterinarian—Dr. D. F. Luckey, Columbia.

EXECUTIVE COMMITTEE.

S. H. Prather, Tarkio.
S. W. Hudson, Buckner.
H. J. Waters, Columbia.
W. C. Howell, Ulman.
C. F. Afflick, Clarence.
M. B. Greensfelder, Clayton.
W. C. Hutchison, Jamesport.

EX-OFFICIO MEMBERS.

Governor of Missouri—Jos. W. Folk.
Superintendent of Schools—W. T. Carrington.
Dean Agricultural College—H. J. Waters.

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CORPORATE MEMBERS.

Cong. dist.	Name.	Residence.	County.
	(Term expires July 20, 1906.)		
1	Charles F. Afflick	Clarence	Shelby.
4	S. H. Prather	Tarkio	Atchison.
7	Frank C. Hayman	Houstonia	Pettis.
8	Wm. C. Howell	Ulman	Miller.
15	John J. McNatt	McNatt	McDonald.
	(Term expires July 20, 1907.)		
6	John Deerwester	Butler	Bates.
9	J. A. Potts	Mexico	Audrain.
10	M. B. Greensfelder	Clayton	St. Louis.
11	Norman J. Colman	St. Louis City	Holland Bldg.
12	W. R. Wilkinson	St. Louis City	212 N. Main St.
	(Term expires July 20, 1908.)		
2	W. C. Hutchison	Jamesport	Daviess.
3	Allen M. Thompson	Nashua	Clay.
5	S. W. Hudson	Buckner	Jackson.
13	Emmett E. Swink	Farmington	St. Francois.
14	Ferd J. Hess	Charleston	Mississippi.
16	A. T. Nelson	Lebanon	Laclede.

OFFICERS OF STATE FAIR DIRECTORY.

President—A. T. Nelson, Lebanon.
Vice-President—Frank C. Hayman, Houstonia.
Secretary—J. R. Rippey, Sedalia.
Treasurer—Chas. E. Yeater, Sedalia.

EXECUTIVE COMMITTEE STATE FAIR DIRECTORY.

A. T. Nelson, Lebanon.
John Deerwester, Butler.
Frank C. Hayman, Houstonia.
Norman J. Colman, St. Louis.
E. E. Swink, Farmington.
C. F. Afflick, Clarence.
A. M. Thompson, Nashua.

STATE VETERINARIAN AND DEPUTIES.

D. F. Luckey, State Veterinarian	Columbia
Logan Allen, Deputy State Veterinarian	Columbia
Horace Bradley, Deputy State Veterinarian	Windsor
E. Brainerd, Deputy State Veterinarian	Memphis
W. L. Berry, Deputy State Veterinarian	Joplin
L. D. Brown, Deputy State Veterinarian	Hamilton
Henry Boettner, Deputy State Veterinarian	Perryville
James Cullison, Deputy State Veterinarian	Charleston
Chas. Doerrie, Deputy State Veterinarian	Boonville
H. V. Goode, Deputy State Veterinarian	St. Joseph
E. M. Hendy, Deputy State Veterinarian	Jefferson City
R. B. Love, Deputy State Veterinarian	Springfield
R. C. Moore, Deputy State Veterinarian	Kansas City
H. M. McConnell, Deputy State Veterinarian	Marshall
F. W. O'Brien Deputy State Veterinarian	Hannibal
R. P. Poage, Deputy State Veterinarian	Shelbina
J. H. Slater, Deputy State Veterinarian	Richmond
Sam Sheldon, Deputy State Veterinarian	Trenton
Stanley Smith, Deputy State Veterinarian	Columbia
T. E. White, Deputy State Veterinarian	Sedalia
H. H. Wolf, Deputy State Veterinarian	Maryville

Associate Organizations.

IMPROVED LIVE STOCK BREEDERS' ASSOCIATION.

President—T. J. Wornall, Liberty.
Vice-President—A. M. Thompson, Nashua.
Vice-President—Hugh Elliot, Estill.
Vice-President—L. E. Frost, Moberly.
Vice-President—J. W. Boles, Auxvasse.
Vice-President—J. H. McCulloh, Creighton.
Secretary—George B. Ellis, Columbia.
Treasurer—Clarence Ragsdale, Moberly.
Executive Committee—W. P. Harned, Vermont; Benton Gabbert, Dearborn, and above officers.

MISSOURI CORN GROWERS' ASSOCIATION.

President—E. E. Laughlin, Rich Hill.
Vice-President—C. O. Raine, Canton.
Vice-President—Geo. H. Sly, Rockport.
Vice-President—G. M. Tucker, Blodgett.
Vice-President—P. E. Crabtree, Hannon.
Vice-President—V. L. Rehin, Crocker.
Secretary and Treasurer—M. F. Miller, Columbia.

MISSOURI STATE DAIRY ASSOCIATION.

President—Dr. Geo. C. Mosher, Kansas City.
First Vice-President—J. M. Smith, Brookfield.
Second Vice-President—Thos. Shields, Eureka.
Secretary—R. M. Washburn, Columbia.
Treasurer—D. B. Matthews, Kirksville.

LETTER OF TRANSMITTAL.

State Board of Agriculture, Office of the Secretary,
Columbia, Mo., March 1, 1906.

To His Excellency, Joseph W. Folk, Governor of Missouri:

Sir—I have the honor to transmit herewith copy of the thirty-eighth annual report of the State Board of Agriculture for the year 1905.

The year 1905 was a fairly prosperous year for Missouri farmers, and their prosperity has contributed largely to the general prosperity of the State. The farmers each year are manifesting a greater interest in improved scientific methods; and the work of the Agricultural College, Experiment Station and the Board of Agriculture seems to be appreciated more and more each year. Besides the minutes of the annual meeting and the annual reports of the Secretary and State Veterinarian, and the crop statistics for the year 1905, this report contains a number of practical papers treating of various topics of interest to the farmers, live stock breeders and others wanting to learn of the agricultural progress of Missouri.

Trusting that our humble efforts may result in increased prosperity, not alone to the farmers, but to all other classes of the people of this great State, and that our work may be a contributing factor to the success of your administration, I remain,

Yours Respectfully,
GEORGE B. ELLIS, Secretary.

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ANNUAL MEETING.

MINUTES OF PROCEEDINGS.

State Board of Agriculture,
Office of the secretary, Columbia, Mo., Dec. 19, 1905.

In compliance with the provisions of the law, the State Board of Agriculture convened in the Secretary's office in 41st annual session at 7:30 p. m. December 19, 1905. The Board was called to order by the President, and upon call of the roll by the Secretary, the following members were present.

Ex-officio—W. T. Carrington and H. J. Waters.

Corporate Members Present—C. F. Afflick, W. C. Hutchison, Allen M. Thompson, S. H. Prather, S. W. Hudson, John Deerwester, Frank C. Hayman, W. C. Howell, M. B. Greensfelder, Norman J. Colman, E. E. Swink and A. T. Nelson.

Those absent:

Ex-officio—The Governor, Joseph W. Folk.

Corporate Members—J. A. Potts, W. R. Wilkinson, Ferd J. Hess, and J. J. McNatt.

Upon motion of Mr. Carrington, the Board took a short recess to allow a meeting of the State Fair Directors.

Board called to order after the recess at 8:20 p. m.

Upon motion of Mr. Waters, the reading of the minutes of the last meeting was dispensed with and the minutes adopted as printed in the 37th annual report.

The Secretary read his report, and upon motion of Governor Colman, the report was approved and ordered printed in the 38th annual report.

The State Veterinarian read his report, and on motion of Mr. Carrington, the report was accepted and ordered printed in the annual report.

Moved by Mr. Carrington that the recommendations made by the State Veterinarian, with reference to the appointment of one or more assistants or deputies, be approved and the Executive Committee be authorized and instructed to carry the suggestions into effect. Motion carried.

The State Veterinarian submitted the following order and asked for approval of the Board: "The Missouri State Board of Agriculture hereby authorizes the State Veterinarian to issue a permit to any responsible butcher firm in the State of Missouri to handle southern cattle for immediate slaughter; provided, that upon examination of the plant by the State Veterinarian the pens and chutes are found to be so constructed and arranged as to be safely used for handling southern cattle; provided further, that the person or firm who secures the permit shall first enter into a bond with the State of Missouri to the amount of $1,000.00 to comply with the rules prescribed by the State Veterinarian for handling the southern cattle, and to the amount of $5,000.00 to indemnify anyone for the loss of any cattle which may result from the non-compliance with such rules. In addition to this, the person or firm to whom the permit is granted by the State Veterinarian shall, before the permit is delivered, file with the Secretary of the State Board of Agriculture a plot of the plant showing all pens and chutes in connection therewith."

After a full discussion of the subject, Mr. Hayman moved that the recommendation of the State Veterinarian, relating to granting slaughter permits, be referred to the Executive Committee, who are granted full power to act in each particular case. Motion carried.

Mr. Waters called up for discussion the recommendation of the Executive Committee relating to additional help for the Secretary. After some discussion, Governor Colman offered the following motion: That the Executive Committee be empowered to employ the necessary office assistance for the Secretary. Motion unanimously adopted.

The Agricultural College Committee submitted the following report:

REPORT OF COLLEGE OF AGRICULTURE COMMITTEE.

We, your committee appointed to examine into the affairs of the College of Agriculture and Experiment Station, beg to submit the following report:

The College of Agriculture and Mechanic Arts consists of the following schools:

a. School of Agriculture.
b. Experiment Station.
c. School of Engineering.

The School of Agriculture is divided into the following departments:

1. *Agronomy;* one professor, one instructor, two assistants.
2. *Animal Husbandry;* two professors, one assistant professor, two assistants, one herdsman.
3. *Horticulture;* one professor, one assistant professor, one instructor, one assistant.
4. *Entomology;* one professor, one instructor.
5. *Veterinary Medicine;* one professor, one instructor.
6. *Agricultural Chemistry*; one professor, one assistant professor.
7. *Dairying*; one professor, one instructor, one assistant.
8. *Botany;* one professor, two instructors, one assistant.
9. *Domestic Science;* which at the present time is without a head.

The Experiment Station is divided into *Agronomy,* including soil fertility, plant propagation, crop rotation. *Animal Husbandry,* including investigations in animal nutrition and animal breeding. *Horticulture,* including the entire range of plant production, fruit growing, orchard management and vegetable growing. *Entomology,* including a study of the life histories and methods of combating insects. *Veterinary Medicine,* including a study of the important contagious diseases of the live stock of Missouri. *Dairying,* including the manufacture of butter and cheese and the handling of city milk supplies. *Agricultural Chemistry,* including the fertilizer control work, and the soil survey, which is a co-operative effort between the Departments of *Agronomy, Agricultural Chemistry* and *Geology,* intended to point out ultimately the exact chemical composition, value, adaptability to different crops, and productive capacity of each type of soil in Missouri, and to point out the best methods of handling the same.

The officers of the Experiment Station are, in the main, the same as the officers of the College of Agriculture, and divide their time between instructional work and research work. Their salaries are paid in part from the funds of the Agricultural College and in part from the funds of the Experiment Station, provided by the Federal Government.

We find the buildings, grounds and live stock in good condition.

We find a new, commodious and excellent cattle barn just being completed for the use of the beef breeds of live stock.

We find the old dairy barn of a character unsuited to the uses and needs of an Agricultural College, and strongly recommend that the Board of Curators include in its next request to the Legislature an item sufficient to provide adequate accommodations for the splendid dairy herd the College now owns.

The experimental work in beef production now being conducted by the Experiment Station in co-operation with the United States Government is especially to be commended, on account of its magnitude, its practical plan, the important problems involved, and the excellent quality of the cattle in use.

We desire further to especially commend the Soil Survey of Missouri recently inaugurated by the Experiment Station, and to urge upon the Legislature the importance of its continuance and the necessity for providing adequately for its support.

We congratulate the Board of Curators of the University upon securing the services of such a capable corps of investigators, instructors and assistants.

We find the facilities for work in *Veterinary Science* and *Animal Diseases* wholly inadequate and not in proportion to the importance of the department or to the equipment of the other departments of the College, and we would strongly urge the Board of Curators to request an appropriation from the next Legislature of at least $50,000 for a suitable veterinary laboratory and hospital.

We especially commend the co-operative effort between the College of Agriculture and the Teachers' College of the University in the preparation of teachers to give instruction in Agriculture in the public schools of the State, and we recommend that the Board of Curators employ a special man, whose sole duties shall be to encourage the introduction of agriculture and other industrial subjects into the public schools.

Very respectfully submitted,
S. W. HUDSON,
A. M. THOMPSON,
W. T. CARRINGTON.

The report was unanimously adopted.

REPORT OF AUDITING COMMITTEE.

The Auditing Committee submitted the following report:

We, the undersigned committee, authorized to examine the books and accounts of the Secretary and Treasurer, beg leave to submit the following report:

We have carefully examined the vouchers authorized by the Executive Committee and the corresponding warrants issued by the President and Secretary of the different funds of the Board as follows;

DISTRIBUTION ANNUAL REPORT FUND.

We find that vouchers Nos. 117-124, inclusive, for a total amount of $600.00, have been approved and corresponding warrants issued and paid, leaving no balance in said fund.

MONTHLY CROP REPORT FUND.

We find that vouchers Nos. 322-356, inclusive, for a total amount of $834.32, have been approved and corresponding warrants issued and paid, leaving a balance in the hands of the Treasurer of the Board of $125.39.

EXPENSE OF MEMBERS FUND.

We find that vouchers Nos. 582-612, inclusive, have been approved to the amount of $468.67, and corresponding warrants issued, leaving a balance of $396.25 in the hands of the Treasurer of the Board.

FARMERS' INSTITUTE FUND.

We find that vouchers Nos. 617-692, inclusive, have been approved for a total amount of $3,333.32, and corresponding warrants issued, leaving a balance unappropriated of $369.51. In this fund the Treasurer's statement shows that warrants Nos. 684, 686, 688 and 689, for a total amount of $297.05, have not yet been presented for payment, leaving a balance in the hands of the Treasurer of $666.56. When these warrants are paid there will be an exact agreement with the books of the Secretary and Treasurer.

OFFICE EXPENSE FUND.

We find that vouchers Nos. 534-574, inclusive, for a total amount of $455.40, have been approved and corresponding warrants issued and paid by the Treasurer, leaving a balance of $103.33 in the hands of the Treasurer.

STATE VETERINARY FUND.

We find that vouchers Nos. 1607-1718, inclusive, for a total amount of $6,250.45, have been approved and corresponding warrants issued, leaving a balance unappropriated of $609.66. In this fund the Treasurer's statement shows that warrants Nos. 1712 and 1713, for the amount of $134.85, have not yet been presented for payment, leaving a balance in the hands of the Treasurer of $744.51. When these warants are paid there will be an exact agreement of the books of the Secretary and Treasurer.

The above statement shows an exact agreement as to expenditures and balances between the books of the Secretary and Treasurer, except the unpaid warrants, as above noted.

All of which is respectfully submitted.

F. C. HAYMAN,
W. C. HUTCHISON,
JOHN DEERWESTER.

The report was unanimously adopted.

ELECTION OF OFFICERS.

Mr. S. H. Prather was nominated for President. Upon motion of Governor Colman, the rules were suspended and the Secretary was instructed to cast the unanimous ballot of the Board for S. H. Prather for President. Mr. Prather was declared elected President.

Upon motion of Governor Colman, the rules were suspended and the Secretary was instructed to cast the unanimous ballot of the Board for S.,W. Hudson as Vice-President. Mr. Hudson was declared elected.

Upon motion of Mr. Carrington, the rules were suspended and the President was authorized to cast the unanimous ballot of the Board for Geo. B. Ellis for Secretary. Mr. Ellis was declared elected.

Upon motion of Dean Waters, the rules were suspended and the Secretary was authorized to cast the unanimous ballot of the Board for Miss J. B. Rector for Assistant Secretary. Miss Rector was declared elected.

Mr. Hayman stated that he was authorized to say to the Board that Mr. H. H. Banks, the Treasurer, was not an applicant for re-election. Upon motion of Mr. Nelson, the Secretary was authorized to cast the unanimous ballot of the Board for W. A. Bright for Treasurer. Mr. Bright was declared elected.

Upon motion of Mr. Carrington, the following members were elected members of the Executive Committee: S. H. Prather, S. W. Hudson, H. J. Waters, W. C. Howell, M. B. Greensfelder, C. F. Afflick and W. C. Hutchison.

There being no further business, the Board adjourned to meet in the office of the Secretary on January 11, 1906, at 4 o'clock p. m.

GEO. B. ELLIS, Secretary.
C. F. AFFLICK, President.

SECRETARY'S REPORT.

Gentlemen of the Board of Agriculture:

You are now assembled in the forty-first annual session of your honorable body that you may hear the reports of your officers concerning the work of the past year, and also that you may deliberate and plan for the future welfare and development of the agricultural interests of the great commonwealth of Missouri. There has perhaps never before been a time when all classes so fully realized that agriculture is the mainstay of the country as they do now, and there has probably never before been a time when the general average condition of our farmers was more prosperous than it is today; and I am gratified to record the fact that Missouri farmers have a full share in that prosperity.

Missouri, containing only one-fiftieth of the land area of the United States, has this year produced one-eleventh of the corn and one-twentieth of the wheat of the entire country, and had it not been for unprecedented storms, which swept the State during the months of August and September, we would have made a much better showing for the industry and thrift of our farmers. With our bountiful crops, and prices for grains and live stock fairly remunerative, the farmers of the State are able to enjoy to a greater degree than ever before those things which make a people better, happier and more intelligent. That our farmers are an intelligent and progressive class of people is, I think, clearly proven by the fact that during the last four years the yield of corn, our principal field crop, has been greater than for any previous consecutive four years in the history of the State. The total yield of corn for the last four years has been 131.4 bushels per acre, or an average yearly yield of 32.8 bushels. This shows that our farmers are at least maintaining at par the fertility of the land. In making up this average, it should be stated that many of our counties make a much larger yield, and that this average includes every acre of the poorer districts of the State not so well adapted to corn cultivation.

For the same four years—1902-1905, inclusive—the average yield of corn in Iowa, one of the greatest corn states in the Union, was only 31.8 bushels, or one bushel less than the average yield in Missouri. In Nebraska, another great corn state, for the same period, the average annual yield was 30.9 bushels, or 1.9 bushels less than in Missouri; and in Kansas, on the west, another border state, the average yield was only 26 bushels, or 6.8 bushels less than our own farmers have produced. The only state among the leading corn states of the Union showing a greater average yield per acre, during the last four years, is Illinois; but while this comparison is very favorable to Missouri farmers, we, as their representatives for improved agriculture, should not be satisfied until every acre in the State is made to yield a maximum crop. By applying well-established scientific methods, the average yield of corn in this State ought to be raised to at least forty bushels per acre—many farmers in the different counties produce a much larger yield.

State Farmers' Conventions.—One means through which this department has been able to accomplish much good is through the State conventions that have been held annually for the past several years under the auspices of the Board of Agriculture. It has been thought wise to establish these State conventions in a permanent home; so, for the last two years they have been held in the Agricultural College.

State Corn Growers' Association.—The second annual meeting of the Missouri Corn Growers' Association, which convened in this building January 12, 1905, has resulted in creating widespread interest in the possibilities of corn improvement in Missouri. Through this convention, and by means of the work that has been done in the regular Farmers' Institutes, hundreds of farmers throughout the State are making a scientific study of corn breeding and a practical application of the scientific methods of tillage and the use of fertilizers. The Board of Agriculture costs the State of Missouri about $20,000 annually, and yet, if the work we are doing in corn improvement will add but two kernels to each ear, we will have added to the wealth of the State for this year alone $177,000—a sufficient sum to maintain the entire work of the Board for several years.

The next, or third annual meeting of this Association, will convene in the Agricultural building, January 9, and promises to be the most successful of any meeting yet held. The officers of this Association should be commended for their patriotic spirit; they are giving their time and of their means without any remuneration whatever.

Improved Live Stock Breeders' Association.—The eighth annual meeting of the Improved Live Stock Breeders' Association was held under the auspices of the Board of Agriculture in the Agricultural College, January 12, 13, 1905, at which time a splendid program was rendered, copy of which was published in the thirty-seventh annual report. Missouri has the soil, the climate, the water, the great variety of nutritious grasses and other feeds, and the intelligent class of farmers necessary to make her the greatest live stock country of the world—a position she is approaching very fast. One object of the Improved Live Stock Breeders' Association is to eliminate the scrub-bred animal from the

State, and make the quality of our stock such that the fact that an animal is bred in Missouri will make it standard everywhere the world over.

The ninth annual meeting of this Association will be held in the Agricultural College during farmers' week, January 9-12, 1906, and the reputation of the men on the program is a sufficient guarantee that a rare treat is in store for those who will attend the meeting. I would like to suggest the advisability of the Board of Agriculture convening in a body during farmers' week in the Agricultural College and lend their assistance to the work that is being promoted by the different state conventions. The officers of this Association, like those of the Corn Growers' Association, give their time, their talent and of their means to the support of the organization without any hope of remuneration whatever.

State Dairy Convention.—The State Dairy Association, while not directly under the auspices of the State Board of Agriculture, has, for the last five years, been given every possible assistance that we could render. The fifteenth annual meeting of this Association was held in Brookfield, February 15-17, 1905; and, I am pleased to say, was the most successful meeting of the Association held up to this time. Largely as a result of that convention, the last Legislature enacted a law providing for the appointment of a State Dairy Commissioner and Assistant. The Governor made these appointments last June, and since that time these officers have been occupied in the up-building of the dairy business of this State. With the proper encouragement from our State Legislature, Missouri is destined in the near future to become the greatest dairy State of the Union.

The sixteenth annual meeting of the State Dairy Association was held November 15-17, 1905, in Jefferson City, and a most excellent program was rendered; and the proceedings of the convention will be published in bulletin form and distributed from this office to the farmers of the State.

State Poultry Association.—I am pleased to say that the differences between the factions, existing in the State Poultry Association, have been settled and that organization is now on a good working basis. We have this year lent the assistance of this office to the officers of the State Poultry Association by giving financial aid from our Institute fund for the holding of a State Poultry Institute at Kirksville, December 12-16. In my opinion no better use of the State's money can be made than for the encouragement and support of the different agricultural associations.

Farmers' Institutes. The general interest in the Farmers' Institute work has been equal to that of previous years. We find, as a rule, the very best and most progressive farmers of the neighborhood attend the meetings and take a deep interest in the discussions. One notable feature of the great interest taken is that in many places the public schools—more especially the high schools—have been dismissed for one session that the pupils might hear the institute lectures. Another means of reaching the young people has been to have the lecturers visit the schools where the meetings are held and deliver talks adapted to the schools on practical agricultural topics. The good effect of this work is usually shown in the increased number of letters received from these communities asking for bulletins and other information.

Agricultural Education.—Last year I made the suggestion that an organized effort be made to bring about the establishment of a system of county and district agricultural schools throughout the State. While I would renew that suggestion now, I realize that many difficulties are in the way toward bringing this condition about at once, and it may require several years to inaugurate a general system of rural agricultural high schools. There is one other suggestion that I would add to the above, and that is that the Board take the necessary steps to have established in our Agricultural College a two years' course to which students shall be admitted directly from the rural schools of the State. Some other states have established such a course in connection with their agricultural college, and I believe it would be a wise movement to provide for it in our own agricultural college.

State Veterinary Work.—I do not deem it necessary to go into detail as to what has been accomplished in this department, as the State Veterinarian will report on the work of his office.

The general live stock sanitary conditions in the State are good, and with proper precautions on the part of our stock men ought to remain so. During the year 235 calls have been made by the State Veterinarian and deputies, as provided for by section 10545, R. S., 1899. Of the total number glanders was found to be the cause of 96 cases with 112 horses or mules affected. Seventy-four of this number were in Kansas City, where most of the glandered horses have been found for the last three years, and only 29 cases, including 43 animals, were found in the State outside of Kansas City. This is a very considerable decrease in the number of cases outside of Kansas City, and a small decrease in Kansas City. If it were possible to do so, I think it would be a wise provision to establish a more rigid system of inspection for Kansas City and use more drastic measures for cleaning up the infection there.

Live Stock Inspection.—At your last annual meeting the Secretary was authorized, by resolution, to discontinue the services of the live stock inspector when in his judgment the services of the inspector were no longer required. Upon the authority of this resolution and at the urgent request of the State Veterinarian, I notified Dr. Robard, the inspector, that his services would be discontinued after April 1. Early in June the State Veterinarian, after a personal investigation of conditions in Southwest Missouri, recommended to the Executive Board the appointment of an inspector to look after the Texas fever infection in Southwest Missouri, and upon the recommendation of the State Veterinarian, Mr. I. H. Collier of Christopher was appointed to that position. Mr. Collier assumed the duties of his office on May 15, and has been continued up to the present time. The table on another page gives the number of cattle quarantined by Mr. Collier on account of Texas fever during the year 1905. The figures show a very large increase of the number of infested cattle above the previous year and indicates the necessity for vigorous measures to prevent the spread of the infested area in the future. Last year there was practically no infested territory, the area being confined to a limited area in three or four townships. This year the infestation has spread to 21 townships. All except one, however, are found south of Joplin and west of a line drawn north and south through Pineville and Neosho. As long as Southeastern Kansas, Northern Arkansas and Indian Territory are infested with fever ticks, it will require diligence on the part of this State to keep the infested areas completely under control.

New Legislation.—Your Board having been made by law guardian of the agricultural interests of the State, it will be wise for you to take such necessary steps as you think prudent that will bring about legislation that will protect and promote agricultural development. I would call your attention to what seems to me an urgent need for a law preventing the fraudulent sale of adulterated human foods and stock feeds. A law should be enacted along the line of the present fertilizer law that would give ample protection to the people of the State. The development of the dairy and poultry interests is causing the placing on the market of a great many concentrated feeding stuffs, and it is of extreme importance that the farmers should have some safeguard against adulterations of these high priced feeds, else the development of these important industries may be greatly retarded.

An important part of the work of this office is the gathering, compiling and publishing of statistical data in regard to crops and live stock. While we think we have a system now established that is reasonably accurate on an estimate basis, yet it would require but little cost to place the system upon a more accurate basis, if we could secure a State statistical law such as is in force in some other states requiring the assessors to furnish official information each year to the Board of Agriculture. The great advantage to the State from a law of this kind would come not only because of the attention it would attract to our resources from the outside world, but in a few years the report would furnish valuable data upon which to base scientific investigations.

Another law that would be of inestimable value to the live stock interests of the State is a breeders license or inspection law. Some of the foreign countries have their standards for improved live stock established by such laws. It would take some years to put a law of this kind into full operation, but it could be brought about gradually without injury to any individual and would be of great advantage to the State. At first it might be necessary to offer the services of the veterinary department of the Board of Agriculture for the purpose of examining the pure-bred animals as to their soundness, similar to what is now being done by the State Veterinarian with cattle in regard to tuberculosis. This inspection should eventually be extended to and including the breeding and individual conformation of the animal, and in time only such male animals as receive the State's approval should be licensed for breeding purposes. With such a law put into force in this State, during the next few years Missouri could easily surpass the world in the quality of live stock, and it would be worth millions to our farmers each year.

Office Assistance Needed.—The work of this office has so increased that it is now impossible to take care of the work in an efficient manner without additional help. This matter was fully discussed by the Executive Committee at their meeting held in this office October 3, and the following resolution was adopted:

Resolved, That it is the sense of this committee that the work of the Secretary's office has increased during the past few years to such an extent as to require help of a character that is able to assume some of the responsibilities of the office. It is, therefore, recommended to the full Board that if it is possible within the limit of the funds of the Board that such assistance be provided.

Legislative Approval.—We are flattered to believe by the many commendatory letters received from the farmers of the State that we are accomplishing some good by our work through this office. We are also pleased to note the fact that our work is appreciated to a greater degree than ever before by the State Legislature. Last year, at your annual meeting, you recommended the same appropriations that were made for the previous biennial period. Without any solicitation on the part of the Board or officers of the Board, the Legislature increased the appropriation for the publication of the annual report 25 per cent. The increased demand for the report has more than kept pace with the increased number published, and the entire edition will be exhausted before a new edition can be published.

Respectfully,

GEO. B. ELLIS, Secretary.

First prize corn at Clarksville institute, 1905.

SECRETARY'S FINANCIAL STATEMENT.

To the Board of Agriculture:

I beg leave to submit the following exhibit of the financial transactions of the Board for the year beginning December 19, 1904, and ending December 19, 1905, which shows the balances on hand at the beginning of the year, the requisitions drawn on the State Auditor, the warrants drawn on H. H. Banks, Treasurer of the Board, the balances in the Treasury of the Board, and the balances in the different funds remaining in the State Treasury:

DISTRIBUTION OF ANNUAL REPORT FUND.

Date.	War. No.	Name.	Dr.	Cr.
1905.				
July 5		To requisition	$600 00	
Aug. 1	117	By S. H. Elkins		$140 00
" 1	118	Pacific Express Co		71 16
" 1	119	American Express Co		56 34
" 1	120	Missouri, Kansas & Texas R. R.		36 83
Sept. 1	121	American Express Co		77 39
" 1	122	Pacific Express Co		174 33
" 1	123	Missouri, Kansas & Texas R. R.		33 72
" 1	124	S. H. Elkins		10 23
			$600 00	$600 00

MONTHLY CROP REPORT FUND.

Date.	War. No.	Name.	Dr.	Cr.
1904.				
Dec. 21		To balance	$159 71	
1905.				
Jan. 2	322	By H. H. Banks		$5 00
" 2	323	Missouri Statesman		4 00
Mch. 6	324	Missouri Statesman		49 30
April 6	325	Missouri Statesman		49 00
" 6	326	S. H. Elkins		10 00
" 6	327	S. H. Elkins		5 94
May 4	328	Missouri Statesman		39 50
" 4	329	National Paper Co		50 00
" 4	330	National Paper Co		5 00
" 4	331	S. H. Elkins		10 00
" 4	332	Columbia Tppewriter Exchange		33 90
" 4	333	S. H. Elkins		20 00
" 4	334	S. H. Elkins		2 91
" 4	335	G. F. Troxell		19 50
" 4		To requisition	300 00	
June 8	336	By Columbia Statesman		10 00
" 8	337	Missouri Statesman		2 00
" 8	338	S. H. Elkins		20 00
" 8	339	S. H. Elkins		5 68
July 5	340	Columbia Statesman		78 30
" 5	341	S. H. Elkins		14 13
" 5		To requisition	100 00	
Aug. 1	342	By S. H. Elkins		14 11
" 1	343	National Paper Co		18 17
" 1	344	Columbia Typewriter Exchange		13 85
Sept. 1	345	Columbia Statesman		52 50
" 1	346	S. H. Elkins		24 88
" 1		To requisition	100 00	

MONTHLY CROP REPORT FUND—Continued.

Date.	Check No.	Name.	Dr.	Cr.
Oct. 3	347	By S. H. Elkins		8 25
" 3	348	Columbia Statesman		98 50
" 3	349	S. H. Elkins		20 00
" 3		To requisition	100 00	
Nov. 1	350	By S. H. Elkins		15 10
" 1	351	S. H. Elkins		38 00
" 1	352	Columbia Statesman		4 00
" 1	353	Pacific Express Co		24 80
Dec. 1	354	S. H. Elkins		5 00
" 1	355	S. H. Elkins		15 00
" 1	356	Columbia Statesman		48 00
" 1		To requisition	200 00	
" 19		By balance		125 39
			$959 71	$959 71

EXPENSE OF MEMBERS' FUND.

Date.	War. No.	Name.	Dr.	Cr.
1904.				
Dec. 19		To balance	$464 92	
" 21	582	By F. C. Hayman		$12 00
" 21	583	W. C. Howell		15 00
" 21	584	J. J. Conrad		27 45
" 21	585	N. J. Colman		12 00
" 21	586	John Deerwester		14 45
" 21	587	C. F. Afflick		12 50
" 21	588	S. H. Prather		25 00
" 21	589	J. J. McNatt		29 40
" 21	590	A. T. Nelson		27 60
" 21	591	W. T. Carrington		3 78
1905.				
Jan. 2	592	Geo. B. Ellis		5 00
Feb. 6	593	J. J. Conrad		14 80
" 6	594	F. B. Mumford		3 90
" 6	595	Geo. B. Ellis		10 15
May 4	596	J. J. Conrad		12 40
" 4	597	C. F. Afflick		16 00
" 4	598	F. B. Mumford		13 20
" 4	599	W. C. Howell		18 50
" 4	600	Geo. B. Ellis		18 75
June 8	601	J. J. Conrad		8 18
" 8	602	W. C. Howell		15 00
" 8	603	F. B. Mumford		12 65
" 8	604	Geo. B. Ellis		11 30
" 8	605	C. F. Afflick		15 00
July 5	606	W. C. Howell		12 00
Aug. 1		To requisition	100 00	
Sept. 1	607	By W. C. Howell		16 20
" 1	608	J. J. McNatt		18 50
" 1	609	S. H. Prather		15 00
" 1	610	Geo. B. Ellis		13 96
Oct. 3	611	J. J. McNatt		26 50
" 3	612	C. F. Afflick		12 50
Dec. 1		To requisition	300 00	
" 9		By balance		396 25
			$864 92	$864 92

FARMERS' INSTITUTE FUND.

Date.	War. No.	Name.	Dr.	Cr.
1904.				
Dec. 19		To balance	$1,002 83	
1905.				
Jan. 2	617	By H. H. Banks		$20 00
" 2	618	Missouri Statesman		31 50
" 2	619	Geo. B. Ellis		50 00

FARMERS' INSTITUTE FUND—Continued,

Date.	War. No.	Name.	Dr.	Cr.
Feb. 6	620	Geo. B. Ellis		50 00
“ 6	621	Pacific Express Co		5 50
“ 6	622	Columbia Telephone Co		8 55
“ 6	623	G. M. Tucker		19 15
“ 6	624	Barnes-Crosby Co		16 35
“ 6	625	Smith-Premier Typewriter Co		6 25
Mch. 6	626	Missouri Statesman		14 00
“ 6	627	Geo. B. Ellis		50 00
“ 6	628	Geo. M. Tucker		37 80
“ 6	629	National Paper Co		4 13
“ 6	630	Barnes-Crosby Co		9 30
April 6	631	Geo. B. Ellis		50 00
“ 6	632	Missouri Statesman		93 50
“ 6	633	American Express Co		1 35
May 4	634	Missouri Statesman		114 20
“ 4	635	National Paper Co		50 00
“ 4	636	D. Ward King		75 70
“ 4	637	Geo. B. Ellis		50 00
“ 4	638	Columbia Typewriter Exchange		12 25
“ 4	639	Barnes-Crosby Co.		4 65
June 8	640	Columbia Statesman		225 50
“ 8	641	Michaelis Engraving Co		5 50
“ 8	642	Wabash R. R. Co		4 23
“ 8	643	Pacific Express Co		3 70
“ 8	644	American Express Co		3 49
“ 8	645	Geo. B. Ellis		50 00
“ 8		To requisition	500 00	
July 5	646	By Geo. B. Ellis		50 00
“ 5	647	S. H. Elkins		20 00
Aug. 1	648	Barnes-Crosby Co.		14 10
“ 1	649	S. H. Elkins		70 00
“ 1	650	Geo. B. Ellis		50 00
Sept. 1	651	Geo. B. Ellis		50 00
“ 1	652	National Paper Co		6 88
“ 1	653	Columbia Telephone Co		7 95
“ 1	654	Columbia Statesman		4 00
“ 1	655	Missouri Statesman		12 00
“ 1	656	Barnes-Crosby Co.		4 80
“ 1	657	S. H. Elkins		50 00
Oct. 3	658	Geo. B. Ellis		50 00
“ 3	659	Columbia Telephone Co		2 80
“ 3	660	D. P. Ashburn		95 48
“ 3	661	Geo. B. Ellis		12 63
“ 3	662	Columbia Statesman		8 50
“ 3		To requisition	1,000 00	
Nov. 1	663	By Columbia Telephone Co		5 75
“ 1	664	J. M. Stedman		31 41
“ 1	665	H. J. Waters		51 51
“ 1	666	M. F. Miller		11 62
“ 1	667	P .E. Crabtree		151 30
“ 1	668	M. F. Miller		21 46
“ 1	669	American Express Co		2 14
“ 1	670	J. C. Whitten		31 21
“ 1	671	Dr. Paul Schweitzer		55 14
“ 1	672	D. Ward King		284 07
“ 1	673	Geo. W. Williams		49 15
“ 1	674	E. E. Laughlin		49 60
“ 1	675	Smith-Premier Typewriter Co		2 71
“ 1	676	S. A. Hoover		9 57
“ 1	677	J. H. Gwaltney		117 89
“ 1	678	Geo. B. Ellis		50 00
“ 1		To requisition	1,200 00	
Dec. 1	679	By Geo. W. Williams		14 33
“ 1	680	D. P. Ashburn		125 26
“ 1	681	M. F. Miller		43 34
“ 1	682	J. B. Tiffany		15 87
“ 1	683	C. M. Lewlling		191 28
“ 1	684	E. E. Laughlin		49 46
“ 1	685	American Express Co		3 09
“ 1	686	G. W. Waters		224 44
“ 1	687	Geo. B. Ellis		50 00
“ 1	688	E. B. Forbes		4 42
“ 1	689	C. H. Eckles		4 40
“ 1	690	S. H. Elkins		60 00
“ 1	691	Dr. Paul Schweitzer		17 09
“ 1	692	Geo. B. Ellis		30 07
“ 19		To balance		369 51
			$3,702 83	$3,702 83

SECRETARY'S ACCOUNT.

Date.	Check No.	Name.	Dr.	Cr.
1904.				
Dec. 19		By error, account R. M. Washburn, Oct. 12, '04, No. 71		01
" 19		To balance	$1,258 71	
" 21	101	By S. H. Elkins		$5 00
" 21	102	F. L. Kelso		10 00
" 22	103	A. J. Detweiler		38 52
" 22	104	Elmer Laughlin		87 55
" 23	105	M. F. Miller		20 19
" 23	106	R. M. Washburn		53 85
" 23	107	R. M. Bird		13 05
" 23	108	G. W. Waters		144 61
1905.				
Jan. 3	109	S. H. Elkins		30 00
" 3	110	W. A. Cochel		10 00
" 12	111	American Express Co		8 12
" 16	112	F. B. Mumford		14 11
" 17	113	Elmer Laughlin		12 65
" 19	114	W. P. Harned		9 20
" 20	115	Columbia Typewriter Exchange		3 00
" 23	116	G. W. Waters		18 05
" 28	117	Benton Gabbert		10 60
" 30	118	D. Ward King		116 93
Feb. 4	119	Geo. B. Ellis		10 05
" 4	120	G. A. Atwood		25 00
" 7	121	S. B. Willis		10 00
" 7	122	E. W. Stephens		3 00
" 13	123	American Express Co		2 31
" 18	124	Shannon Mountjoy		15 00
" 20	125	S. B. Willis		29 47
Mch. 1	126	S. H. Elkins		2 80
" 10	127	Geo. B. Ellis		11 50
" 10	128	G. W. Waters		50 00
April 4	129	R. M. Washburn		39 63
" 4	130	G. W. Waters		30 35
" 5	131	F. B. Mumford		4 41
" 11	132	C. H. Smalley		9 70
May 4	133	Michaelis Engraving Co		13 77
" 29	134	J. W. Waller		1 50
June 27	135	S. H. Elkins		70 00
July 6	136	S. H. Elkins		2 00
" 18	137	D. Ward King		33 05
" 28	138	S. H. Elkins		70 00
" 29	139	Eloise Kneisley		3 75
Aug. 4	140	S. H. Elkins		5 00
" 7	141	C. H. Eckles		10 10
" 8	142	G. W. Waters		44 75
" 10	143	Mary Fisher		2 60
" 12	144	Eloise Kneisley		4 50
" 12	145	S. H. Elkins		14 00
" 17	146	S. H. Elkins		16 00
" 28	147	S. H. Elkins		15 00
Sept. 4	148	M. F. Miller		6 52
" 12	149	Smith-Premier Typewriter Co.		5 00
" 12	150	J. L. Hall		5 60
" 27	151	G. W. Waters		50 00
Oct. 16	152	R. L. Baldwin		2 50
" 19	153	G. W. Waters		34 24
Nov. 10	154	E. F. Ammerman		7 22
" 18	155	Geo. B. Ellis		14 79
" 18	156	Nora K. Hall		12 59
" 18	157	J. B. Rector		27 79
" 20	158	J. E. Pope		11 85
" 25	159	S. H. Elkins		5 00
" 25	160	Eloise Kneisley		1 50
Dec. 1		To warrant No. 692 on Farmers' Institute Fund.	30 07	
			$1,288 78	$1,288 78

OFFICE EXPENSE FUND.

Date.	War. No.	Name.	Dr.	Cr.
1904.				
Dec. 19......	....	To balance	$158 73	
1905.				
Jan. 2......	534	By Snowdon Willis	....	$10 00
" 2......	535	J. Russell Ellis	....	17 08
Feb. 6......	536	Snowdon Willis	....	10 00
" 6......	537	Columbia Gas Works	....	6 40
" 6......	538	J. R. Ellis	....	16 25
Mch. 6......	539	J. R. Ellis	....	16 40
" 6......	540	Snowdon Willis	....	10 00
" 6......	541	W. E. Harshe	....	4 10
April 6......	542	Snowdon Willis	....	10 00
" 6......	543	J. R. Ellis	....	15 87
May 4......	544	National Paper Co.	....	50 00
" 4......	545	National Paper Co.	....	13 68
" 4......	546	Columbia Typewriter Exchange	....	10 00
" 4......	547	Snowdon Willis	....	10 00
" 4......	548	Columbia Typewriter Exchange	....	16 85
" 4......	549	J. R. Ellis	....	16 20
" 4......	....	To requisition	100 00	
June 8......	550	By Snowdon Willis	....	10 00
" 8......	551	J. Russell Ellis	....	15 65
" 8......	552	G. F. Troxell	....	2 00
" 8......	....	To requisition	100 00	
July 5......	553	By Snowdon Willis	....	10 00
" 5......	554	W. E. Harshe	....	95
" 5......	555	W. R. Nifong	....	4 75
" 5......	556	C. C. Newman & Co.	....	5 00
" 5......	557	J. R. Ellis	....	15 49
" 5......	558	Columbia Statesman	....	5 00
Aug. 1......	559	J. R. Ellis	....	17 04
" 1......	560	Snowdon Willis	....	10 00
" 1......	561	John B. Wilson	....	5 00
Sept. 1......	562	Snowdon Willis	....	10 00
" 1......	563	J. L. Hall	....	16 18
" 1......	564	W. E. Harshe	....	1 45
" 1......	....	To requisition	100 00	
Oct. 3......	565	By H. M. Hart....................................	....	9 25
" 3......	566	J. R. Ellis	....	18 23
Nov. 1......	567	J. R. Ellis	....	16 58
" 1......	568	Parker Furniture Co.	....	3 50
" 1......	569	Columbia Typewriter Exchange	....	2 00
" 1......	570	W. E. Harshe	....	2 20
Dec. 1......	571	Smith-Premier Typewriter Co.	....	14 00
" 1......	572	J. B. Rector	....	8 35
" 1......	573	J. R. Ellis	....	15 80
" 1......	574	W. E. Harshe	....	4 15
" 1......	....	To requisition	100 00	
" 19......	....	By balance	....	103 33
			$558 73	$558 73

STATE VETERINARY FUND.

Date.	War. No.	Name.	Dr.	Cr.
1904.				
Dec. 19		To balance	$860 11	
" 21	1607	By E. M. Hendy		$8 00
" 21	1608	H. V. Goode		10 25
" 21	1609	Jesse Robards		121 25
" 21	1610	R. B. Love		43 50
" 21	1611	W. F. Berry		16 60
" 21	1612	E. F. Ammerman		4 32
1905.				
Jan. 2	1613	Nora K. Hall		50 00
" 2	1614	F. W. O'Brien		44 99
" 2	1615	R. B. Love		5 00
" 2	1616	R. P. Poage		19 60
" 2	1617	D. F. Luckey		221 36
" 2	1618	S. H. Ward		10 00
" 2	1619	H. H. Banks		25 00
Feb. 6	1620	Nora K. Hall		50 00
" 6	1621	S. H. Elkins		21 20
Mch. 6	1622	Nora K. Hall		50 00
" 6	1623	Missouri Statesman		3 00
April 6	1624	Nora K. Hall		50 00
" 6	1625	Missouri Statesman		3 75
" 6	1626	F. W. O'Brien		23 31
" 6	1627	H. H. Wolf		8 00
" 6	1628	Samuel Sheldon		8 40
" 6	1629	T. E. White		6 10
" 6	1630	Stanley Smith		26 15
" 6	1631	R. P. Poage		8 50
" 6	1632	E. F. Ammermasn		9 17
May 4	1633	H. V. Goode		53 29
" 4	1634	Missouri Statesman		2 50
" 4	1635	Columbia Typewriter Exchange		12 03
" 4	1636	James Cullison		20 30
" 4	1637	Nora K. Hall		50 00
" 4	1638	J. H. Slater		7 28
" 4	1639	E. M. Hendy		19 50
" 4	1640	Jesse Robards		398 05
" 4	1641	National Paper Co.		4 00
" 4	1642	W. F. Berry		21 50
" 4	1643	R. C. Moore		125 00
" 4	1644	D. F. Luckey		528 76
" 4	1645	Horace Bradley		64 70
" 4	1646	Horace Bradley		20 84
" 4	1647	D. F. Luckey		227 11
" 4		To requisition	$2,000 00	
June 8	1648	By R. C. Moore		17 00
" 8	1649	R. B. Love		116 41
" 8	1650	Columbia Telephone Co.		7 95
" 8	1651	H. V. Goode		21 59
" 8	1652	I. H. Collier		82 20
" 8	1653	Stanley Smith		24 50
" 8	1654	S. Sheldon		9 15
" 8	1655	W. F. Berry		18 80
" 8	1656	D. F. Luckey		262 07
" 8	1657	Nora K. Hall		50 00
" 8		To requisition	1,000 00	
July 5	1658	By D. F. Luckey		186 19
" 5	1659	R. C. Moore		46 00
" 5	1660	Columbia Statesman		2 00
" 5	1661	Stanley Smith		8 50
" 5	1662	H. H. Wolf		13 00
" 5	1663	Horace Bradley		8 00
" 5	1664	F. W. O'Brien		17 70
" 5	1665	Nora K. Hall		50 00
" 5	1666	I. H. Collier		75 00
" 5	1667	T. E. White		15 30
Aug. 1	1668	E. F. Ammerman		4 01
" 1	1669	R. C. Moore		31 50
" 1	1670	H. V. Goode		16 00
" 1	1671	S. H. Elkins		56 00
" 1	1672	D. F. Luckey		180 45
" 1	1673	I. H. Collier		41 60
" 1	1674	W. F. Berry		17 50
" 1	1675	F. W. O'Brien		29 00
" 1	1676	R. B. Love		54 50
" 1	1677	Nora K. Hall		50 00
" 1	1678	Jas. Cullison		26 94
" 1	1679	I. H. Collier		125 35
" 1		To requisition	1,000 00	

STATE VETERINARY FUND—Continued.

Date.	War. No.	Name.	Dr.	Cr.
Sept. 1	1680	By Nora K. Hall		50 00
" 1	1681	D. F. Luckey		170 28
" 1	1682	Columbia Statesman		50 40
" 1	1683	I. H. Collier		116 35
" 1	1684	E. F. Ammerman		2 91
" 1	1685	M., K. & T. R. R. Co.		12 05
" 1	1686	S. H. Elkins		20 00
Oct. 3	1687	R. C. Moore		105 50
" 3	1688	Nora K. Hall		50 00
" 3	1689	Chas. Doerrie		29 10
" 3	1690	J. H. Slater		17 25
" 3	1691	W. F. Berry		20 50
" 3	1692	J. B. Tiffany		13 50
" 3	1693	Jas. Cullison		19 36
" 3	1694	Stanley Smith		8 50
" 3	1695	Horace Bradley		29 27
" 3	1696	H. V. Goode		15 35
" 3	1697	I. H. Collier		119 40
" 3	1698	D. F. Luckey		252 95
" 3	1699	Columbia Statesman		29 50
" 3		To requisition	1,000 00	
Nov. 1	1700	By R. C. Moore		40 65
" 1	1701	H. V. Goode		17 72
" 1	1702	S. Sheldon		18 15
" 1	1703	Jas. Cullison		30 52
" 1	1704	D. F. Luckey		243 52
" 1	1705	Nora K. Hall		50 00
" 1		To requisition	1,000 00	
Dec. 1	1706	By Blanche Robertson		20 00
" 1	1707	Stanley Smith		16 75
" 1	1708	H. F. Boettner		34 16
" 1	1709	S. Sheldon		14 00
" 1	1710	Tilley & Hatton		9 00
" 1	1711	Jas. Cullison		46 22
" 1	1712	W. F. Berry		26 60
" 1	1713	I. H. Collier		108 25
" 1	1714	Nora K. Hall		30 00
" 1	1715	D. F. Luckey		266 44
" 1	1716	Jas. Cullison		26 38
" 1	1717	R. C. Moore		42 50
" 1	1718	S. H. Elkins		10 90
" 19		By balance		609 66
			$6,860 11	$6,860 11

The above report is a true copy of the financial records of this office.

Respectfully submitted,

GEO. B. ELLIS,
Secretary.

SUMMARY OF SECRETARY'S FINANCIAL STATEMENT.

Printing and Distributing Annual Report Fund

Date.		Dr.	Cr.
December 19, 1904......	To balance in treasury Board of Agriculture.	$0,000 00	
April 17, 1905...........	amount of appropriation	$8,000 00	
December 19, 1904 to December 19, 1905.....	By warrants drawn for distributing annual report	....	$600 00
	amount paid for printing and binding annual report, account with Printing Commission	....	3,462 21
December 19, 1905.......	balance in treasury Board of Agriculture.		$000 00
December 19, 1905.......	balance in State Treasury	....	3,937 79
		$8,000 00	$8,000 00

Monthly Crop Report Fund.

Date.		Dr.	Cr.
December 19, 1904......	To balance in treasury Board of Agriculture.	$159 71	
April 17, 1905............	amount of appropriation	2,000 00	
December 19, 1904, to December 19, 1905....	By warrants drawn on Treasurer Board of Agriculture	....	$834 32
December 19, 1905.......	balance in treasury Board of Agriculture	....	125 39
December 19, 1905.......	balance in State Treasury	....	1,200 00
		$2,159 71	$2,159 71

Expense of Members' Fund.

Date.		Dr.	Cr.
December 19, 1904.......	To balance in treasury Board of Agriculture.	$464 92	
April 17, 1905............	amount of appropriation	$1,200 00	
December 19, 1904, to December 19, 1905....	By warrants drawn on Treasurer Board of Agriculture	....	$468 67
December 19, 1905.......	balance in treasury Board of Agriculture	....	396 25
December 19, 1905.......	balance in State Treasury	....	800 00
		$1,664 92	$1,664 92

Farmers' Institute Fund.

Date.		Dr.	Cr.
December 19, 1904.......	To balance in treasury Board of Agriculture.	$1,002 83	
April 17, 1905............	amount of appropriation	10,000 00	
December 19, 1904, to December 19, 1905....	By warrants drawn on Treasurer Board of Agriculture	....	$3,333 32
December 19, 1905.......	balance in treasury Board of Agriculture	....	369 51
December 19, 1905.......	balance in State Treasury	....	7,300 00
		$11,002 83	$11,002 83

Office Expense Fund.

Date.		Dr.	Cr.
December 19, 1904.......	To balance in treasury Board of Agriculture	$158 73	
April 17, 1905	amount of appropriation	1,000 00	
December 19, 1904, to December 19, 1905.....	By warrants drawn on Treasurer Board of Agriculture	....	$455 40
December 19, 1905.......	balance in treasury Board of Agriculture	....	103 33
December 19, 1905.......	balance in State Treasury	....	600 00
		$1,158 73	$1,158 73

State Veterinary Fund.

Date.		Dr.	Cr.
December 19, 1904	To balance in treasury Board of Agriculture	$860 11	
April 17, 1905	amount of appropriation	16,200 00	
December 19, 1904, to December 19, 1905	By warrants drawn on Treasurer Board of Agriculture		$6,250 45
December 19, 1905	balance in treasury Board of Agriculture		609 66
December 19, 1905	balance in State Treasury		10,200 00
		$17,060 11	$17,060 11

TREASURER'S REPORT.

To the State Board of Agriculture:

I, H. H. Banks, Treasurer Board of Agriculture, submit the following report of the amount of money received from State Treasurer, including balances, and the amounts paid out on warrants presented against the several funds of the Board of Agriculture, and the balances now on hand, all for the year beginning December 19, 1904, and ending December 19, 1905:

Distribution of Annual Report Fund.

Date.		Dr.	Cr.
July 5, 1905	To State warrant	$600 00	
	By warrants paid and canceled		$600 00
		$600 00	$600 00

Monthly Crop Report Fund.

December 21, 1904	To balance	$159 71	
May 4	State warrant	300 00	
July 5	State warrant	100 00	
September 1	State warrant	100 00	
October 3	State warrant	100 00	
December 1	State warrant	200 00	
December 19	By warrants paid and canceled		$834 32
	balance		125 39
		$959 71	$959 71

Expense of Members' Fund.

December 19, 1904	To balance	$464 92	
August 1, 1905	State warrant	100 00	
December 1, 1905	State warrant	300 00	
December 19, 1905	By warrants paid and canceled		$468 67
	balance		396 25
		$864 92	$864 92

Farmers' Institute Fund.

December 19, 1904	To balance	$1,002 83	
June 8, 1905	State warrant	500 00	
October 3, 1905	State warrant	1,000 00	
November 1, 1905	State warrant	1,200 00	
December 19, 1905	By warrants paid and canceled		$3,036 27
	balance		666 56
		$3,702 83	$3,702 83

Secretary's Account.

Date.		Dr.	Cr.
December 19, 1904	By error account R. M. Washburn, Oct. 12, 1904, No. 71		.01
December 19, 1904	To balance .	$1,258 71	
December 1, 1905	warrant No. 692 on Farmers' Institute Fund .	30 07	
December 19, 1905	By warrants paid and canceled		$1,288 77
		$1,288 78	$1,288 78

Office Expense Fund.

December 19, 1904	To balance .	$158 73	
May 4, 1905	State warrant .	100 00	
June 8, 1905	State warrant .	100 00	
September 1, 1905	State warrant .	100 00	
December 1, 1905	State warrant .	100 00	
December 19, 1905	By warrants paid and canceled		$455 40
December 19, 1905	balance .		103 33
		$558 73	$558 73

State Veterinary Fund.

December 19, 1904	To balance .	$860 11	
May 4, 1905	State warrant .	2,000 00	
June 8, 1905	State warrant .	1,000 00	
August 1, 1905	State warrant .	1,000 00	
October 3, 1905	State warrant .	1,000 00	
November 1, 1905	State warrant .	1,000 00	
December 19, 1905	By warrants paid and canceled		$6,115 60
	balance .		744 51
		$6,860 11	$6,860 11

Respectfully submitted,

H. H. BANKS, Treasurer.

REPORT OF STATE VETERINARIAN.

Missouri State Board of Agriculture:

Gentlemen—A table on other pages of the annual report gives an account of the visits made by all official veterinarians in doing State control work. Where it has been impossible for me to attend to the control work in person, and in cases where the mileage and per diem of a deputy amounted to less than my mileage, it has been our policy to have the work done by a deputy. During the year I have tried to do all the control work coming in my section of the State, a report of which can be found with the tabulation of the work of other veterinarians. In addition to doing the control work in my immediate section of the State, I have had occasion at various times to go to extreme portions of the State to make investigations. Aside from the work reported in the table, I have prepared, during the year, a bulletin on the tuberculin test, an account of which is given further on, and have done as much of the tuberculin test work as I could possibly find time to do. During the year I have attended farmers' institutes four weeks, giving special prominence in my lectures to the subject of the tuberculin test and the prevention of tuberculosis among cattle.

In reviewing the State work for the past year, I am able to report that there has been no unusual outbreak of any contagious disease among the live stock of the State. We have had about an average or probably less than the average amount of the various contagious diseases, and I think as little as could possibly be expected, considering the amount of live stock traffic in this State. There is a continual shipment of sheep, cattle and hogs in this State for feeding purposes from the south and west. We are so situated in regard to the horse market that a great number of horses and mules are annually shipped into and out of the State. For years the State of Missouri has been a leader in the production of registered cattle, and for the development of herds large numbers of registered cattle have been imported from all directions, without the consequent spread of any disease except a limited infection of tuberculosis. The dairy interests of the State are today developing rapidly, and while most of the herds are made up of cattle picked up from the locality in which the dairy is started, the improvement of the herds will depend largely upon the importation of well-bred dairy cattle. This will undoubtedly result in the introduction oftuberculosis into our herds, and probably, in a limited way, other contagious diseases.

While we have no means of knowing definitely just what amount of contagious diseases exist in this State, we gain a reasonably accurate idea of the existence of various contagious diseases from our various sources of information in regard to them. It has been the law and custom for years for an investigation to be made by the veterinary service on the receipt of a petition signed by ten freeholders. This privilege is well understood by the laymen of the State and is one of the principal sources of our information in regard to the existence of a contagious disease among any sort of live stock. Four years ago the Board of Agriculture established a precedent of recognizing letters and telegrams from qualified veterinarians over the State notifying us of the existence of contagious diseases, and as a result we have enjoyed the general co-operation of the veterinarians of this State in locating and suppressing contagious diseases. The help that the veterinarians have rendered in this line has been of especial value during the past year. By arrangement with U. S. Bureau of Animal Industry, we receive, by return mail, a notice of the arrival at any of the public stock yards of any live stock in a diseased condition from this State. During the past year we have received notices of the shipment to the public markets from this State of 150 cars of hogs affected with hog cholera; 24 cars of sheep affected with scab, and 7 cars of cattle affected with scabies. It being impossible to do anything in the way of controlling the hog cholera by the ordinary methods of quarantine, no investigation of the source of the infected hogs has been made. In the case of sheep and cattle scabies, the investigation has been ordered of the origin of every shipment. The stock pens from which each shipment was loaded were quarantined and required to be disinfected. The veterinarian making the investigation has invariably quarantined all the infected animals found in the neighborhood from which the shipment originated.

SHEEP SCAB IN LACLEDE COUNTY.

There is one exception to this rule, and that is in connection with the shipments from Laclede county, where sheep scabies is so widespread among the sheep all over the county that a single visit by a veterinarian would accomplish very little. It will take from 4 to 6 weeks for a man to quarantine all the scaby sheep in Laclede county, and no headway can be made in this work until all of the sheep are gotten up off the range. This work can best be done between the first of January and the 15th of April. It will be necessary, in order to handle the outbreak of scabies in Laclede county properly, to employ a competent man to go there and remain until all of the sheep have been quarantined and dipped.

TICK FEVER.

Arrangements have been made with the Federal government whereby the Bureau of Animal Industry furnishes men to guard the southern border of the State against the introduction of fever ticks during the closed season, and attend to the inspection during the inspection season. Our policy has been to attend strictly to the eradication of the fever ticks at points within the State. There is not enough of this work to justify the board in keeping a man permanently employed for this work alone. The important part of this work falls during the month of July, and if a competent man were on the ground during July he could doubtless find and quarantine all of the infected cattle and pastures in the State. The subsequent examination and releasing of quarantines would require an occasional return to the infected areas by a deputy. It seems that it would be much more economical to put a competent man on the ground during the month of July and leave the subsequent part of the work to be done by deputies, from whom only a few visits would be required. Any man who is selected to look after the fever infection should be a well qualified veterinarian who not only understands tick fever, but who has a thorough knowledge of the nature of other contagious diseases. We cannot hope to get the best results from the employment of laymen for doing control work of any kind.

THE TUBERCULIN TEST.

As was explained to the Board at the last annual meeting, the most important line of work falling upon the State veterinary service at the present time is the proper control of tuberculosis among cattle. As was also explained at that meeting that the August bulletin of 1905 would be devoted to the subject of the tuberculin test. This bulletin, while not treating in detail of tuberculosis, gives a brief review of the symptoms of the disease and explains the difficulty in discovering its presence in any herd by any ordinary examination such as could be made by a stockman. It also explains in detail the use that can be made of the tuberculin test, and gives the method of applying it. In the bulletin is announced to the breeders of registered beef cattle and to the dairymen of the State that the State Board of Agriculure will undertake a veterinary inspection of their herds, including the tuberculin test, upon their request, without cost to them. A good many more applications from cattle men have been received for this test than we have been able to answer up to the present time, and it will be necessary for the Board to employ competent help to do this line of work which we are able to do with our present supply of funds. While the application of the tuberculin test is apparently a very simple matter it is necessary, in order to be sure of making a success, to employ the most skillful man that it is possible for us to get to assist in doing this work. Conditions arise in connection with the test which requires the veterinarian using it to have not only an intimate knowledge of the nature of cattle but of the various temperatures and of the symptoms that animals show as the effect of other diseases.

CENTRAL SLAUGHTER HOUSES.

While the matter may not be strictly in line with the preventing of contagious diseases among live stock, the question of sooner or later providing for a system of inspection of meat and milk in the larger towns of the State seems to be an important one. Nothing could be more beneficial by way of promoting the live stock interest of the State than the assurance on the parl of the public that our meat was wholesome and free from disease. Investigations of the matter at the present time will show that the meat which is slaughtered at home towns, say of 4,000 inhabitants, is often killed at as many as three or four or even a half dozen little slaughter houses located some distance away from town. As a rule the country slaughter houses are so filthy as to be considered a nuisance, and are not usually permitted to be maintained within or near the city limits. There is usually not enough of killing at any one of these houses to justify the owner in keeping it clean. Any one who will take the trouble to investigate the matter will find that even though healthy animals are slaughtered at these places, it is next to impossible to dress the carcass without them becoming more or less filthy. In addition to this, there is no restraint whatever at such slaughtering houses upon the killing of diseased stock. During the past year there were 150 cars of hogs sent to the public markets from this State diseased with cholera. Lumpy jaw and tuberculosis and other diseases which would render meat unfit for use are more or less prevalent over the State. There is no telling how much of this diseased stuff is killed at the country slaughtering houses. As they are conducted at the present time, there is no greater argument for the use of dressed meat which comes from the trust packing houses, where all the diseased stuff is condemned by expert meat inspectors. All kinds of food animals are shipped from the various towns of this State to the central markets, slaughtered and shipped back again. If some arrangement could be made for more slaughtering to be done at home the freight on the live animal and on the dressed carcass could be saved. It seems to be a well established fact that the dressed beef that is shipped into the interior of the State by the packing houses, while being free from disease, is inferior in quality to that dressed at home. It seems that it would be a valuable thing if the Board of Agriculture could formulate some plan of encouraging a suitable central slaughter house for each of the larger towns of the State. Such a consummation would doubtless result in good in several different ways. If the killing of live stock at any good sized town could all be done at one plant, only one set of hands would be required to do the killing, and a lot of time would be saved which is now wasted by from three to a half dozen sets of hands going a mile or two to the country to dress just one or two animals each. If there were four slaughter houses in a town, a central slaughtering plant would save the expense of three sets of hands. Another source of economy would be the possibility of utilizing the by-products if all of the animals at an ordinary sized town were killed at one plant. Valuable by-products are thrown away and wasted as the slaughtering is now done, and the loss of these, with the freight to and from the public markets, must come out of the pockets of cattle producers. Another good reason for central slaughtering plants is that the premises would naturally be used more and be better equipped for handling the carcass in a cleanly manner, and it would be kept in a more wholesome condition. Still another advantage is that in an ordinary sized town, with comparatively little expense, a competent inspector could be provided by the city, whereby the live stock could be inspected before and after slaughtering and the public supplied with meat free from disease, and which had not been deteriorated in quality by long cold storage. Another reason for encouraging the slaughtering of live stock at home is to provide a greater number of markets for cattle which would naturally tend to increase the prices that the producers would get. There are a number of things that the Board of Agriculture could do to help in the development of the plan of central slaughtering houses in all of the larger towns of the State, but no one thing would lend more encouragement to the proper course in this matter than the extending to such plants the privilege of handling for immediate slaughter cattle from south of the tick fever quarantine line.

At various centers in Southern Missouri, for the lack of this privilege, southern cattle are shipped, in some cases, 150 miles, dressed and returned for retail. Either the consumer or the producer must pay the extra freight. In the northern part of the State this privilege would not be so essential, but at certain times in each year there is a shortage of fat cattle in many neighborhoods and for a plant of any dimension to run successfully it must have access to fat cattle at all times. It is with a view of supplying cattle in an emergency that the privilege of shipping in southern cattle would be especially convenient to a slaughtering plant in the northern section of the State. It is not probable that southern cattle would be used to any extent if it were possible to secure natives for slaughtering. It might be contended that the shipping of a car of southern cattle now and then into any town in this State would have a tendency to depreciate the value of the natives of that vicinity. While at first glance this seems to be the case, it is not really true. At any point in the State where southern cattle are liable to be handled, dressed meat is freely shipped in. Thousands of southern cattle slaughtered in the central packing plants are sent to such points and sold in competition with the cattle produced at home. There is no way of escaping such competition, and I cannot see that the privilege of handling a few southern cattle at any point in the State could be of any especial detriment. The benefit growing out of the extra number of markets thereby established would outweigh any objections that could be urged against the central slaughtering plants having authority to handle southern cattle. As things exist at the present time the country slaughter house is rapidly going out of existence, and most of the slaughtering is done at the central markets where the buyers are so closely organized that they pay whatever prices they choose for live stock. As to the safety of handling cattle from south of the fever line, I will say that I should not advise it if I thought there was any danger whatever. It is just as safe to handle southern cattle at the slaughtering plants in the interior of the State as it is to handle them at the public markets, and nothing further need be said along that line.

RECOMMENDATIONS.

(1) In view of what has been said in regard to the prevalence of sheep scab in Laclede county, the extra amount of tuberculin test work, and the tick fever investigation in Southwest Missouri, I wish to recommend to the Board, if suitable talent can be obtained, the employment of one, and when necessary, two men to be engaged permanently by the month in doing these lines of work. As has been said, either in tuberculin test, sheep scab or tick fever work the man must not only have a good scientific education but must have combined with it considerable business ability. The work in all of these lines will keep one man busy, if he

can attend to all of it. If he has any time to spare he can be of valuable service to the Board in attending farmers' institutes, and I therefore recommend that the Board ought to employ for the coming year, at least, one competent man as Deputy State Veterinarian, and in case of an unforseen rush of work, the employment of an additional man. As a further reason for this course, I will say that we find it impossible to get any of our deputies to leave their practice for more than a day or two at a time, and it is impossible to keep up with the State work without the services of another man. The funds provided by the last Legislature are ample for carrying out this plan.

(2) That the State Board of Agriculture make the following order, to stand as a part of the policy of the veterinary service:

The Missouri State Board of Agriculture hereby authorizes the State Veterinarian to issue a permit to any responsible butcher firm in the State of Missouri to handle southern cattle for immediate slaughter; provided, that upon examination of the plant by the State Veterinarian the pens and chutes are found to be so constructed and arranged as to be safely used for handling southern cattle; provided further, that the person or firm who secures the permit shall first enter into a bond with the State Veterinarian to the amount of $1,000 to comply with the rules prescribed by the State Veterinarian for handling the southern cattle, and to the amount of $5,000 to indemnify anyone for the loss of any cattle which may result from the non-compliance with such rules. In addition to this, the person or firm to whom the permit is granted by the State Veterinarian shall, before the permit is delivered, file with the Secretary of the State Board of Agriculture a plot of the plant showing all pens and chutes in connection therewith.

(3) That the State Board of Agriculture arrange, if possible, for the manufacture at the Missouri Experiment Station of all the tuberculin needed in the State work.

Respectfully submitted,

D. F. LUCKEY, State Veterinarian.

Farmers' Week in Agricultural College.

January 9-12, 1906.

Third Annual Meeting Missouri Corn Growers' Association and Ninth Annual Meeting Missouri Improved Live Stock Breeders' Association.

(Held under the auspices of the State Board of Agriculture.)

An Abstract of the Addresses Delivered.

OPENING SESSION.

ADDRESS OF WELCOME.

(Dr. J. C. Jones, Acting President, State University.)

Mr. Chairman, Gentlemen of the Farmers' Convention:

In the absence of our President, Dr. Jesse, who, on account of his health, has retired for a brief season from the duties of the University, it becomes my pleasure and my privilege to welcome you to the University of Missouri.

In the first place I want to welcome you to *your* University; it is in every sense the University of the people of this State—supported by them both in regard to money and patronage and from the farmers' sons and daughters by far the larger part of the student corps has for many years been made up and is yet made up and I hope this condition will continue for many many years. I welcome you to your University that within a month I think (perhaps in a shorter period of time) will enroll more than 2,000 students. I welcome you to the University that has all the consolation of age, because it is not a youth and yet has all the vigor and all the enterprise of youth; to the University with a splendid academic department, the famous schools of law and medicine; to an excellent and marvelously growing engineering school; to a young and yet vigorous teachers' college, and to something that will be of most interest to you—to an Agricultural College that in usefulness to the State is unsurpassed by any agricultural college in all this land.

We shall be very glad, indeed, to have you visit all the departments of the University during this convention; every day from 10 to 10:30 we have what we call an assembly of the students in the auditorium. If you are interested in attending this assembly and seeing the students assembled in a body, we shall be very glad to have you present at the time of this assembly. I hope you will not go away from Columbia without inspecting the work of the University. No one ever comes here and goes away, after looking carefully into what the University is doing for the citizens of this State, that he is not pleased with it and proud to know we have such a University in this imperial commonwealth of Missouri. I think it was Bill Nye who said (at least we can put the remark off on him as he is not present) that farming is a very successful and profitable occupation if you can afford it. Now, evidently, when he made that remark he was not thinking about the Missouri farmer and the Missouri stock grower. He must have been thinking about the New England farmer; not the Missouri farmer who can grow everthing on his soil under the influence of the gentle rains and soft sunshine alone. He evidently did not have in mind the Missouri farmer with his broad fields of grain, with his fertile meadows, with his bountiful harvests.

The Missouri farmer of this day is certainly a happy man; and in that connection I am reminded of a story that was told in Columbia recently—so recently, in fact, as perhaps to be remembered by some of you—of a king who was afflicted with nervous prostration—a disease that seems to lie in wait for kings and those who have nothing to do; and his physician told him if he wished to get relief from this dreadful disease he "must wear the shirt of a happy man;" so he sent out into all parts of his kingdom to search for a happy man in order that he might procure his shirt and be relieved from this terrible disease. His messengers searched throughout the kingdom, and at last they found the man who claimed he was happy—perfectly happy. He was a beggar at the city gate; but when they found him it was still impossible for the king to secure the cure which he so much desired, for lo, this beggar didn't have any shirt. What a pity the Missouri farmer did not live in that man's kingdom, for then he would have had no diffiulty in finding a happy man with not only one shirt but with, I dare say, at least two.

The Missouri farmer is not only as happy as a king—*he is a king.* His farm is his kingdom and his flocks, his cattle and his horses are his subjects, his family is his cabinet, and his wife his prime minister. He has subjects that never revolt, and a cabinet that never leaves him under stress of circumstances; and if he wants to talk about his prime minister when his prime minister doesn't do exactly what he wants done, he can go out and talk to his subjects without any danger of having the conversation repeated.

The Missouri farmer is certainly a man to be envied. It is a trite remark enough that agriculture is the basis of our wealth. That is undoubtedly true, but in looking at that truth, in emphasizing that truth, we have lost sight of one far more important, and that is this: That agriculture is not only the basis of our wealth, but agriculture is also the basis of our morality. It is the conservator of our virtues and the safeguard and bulwark of our republic. It is a fact that if we look back over the history of our world for 2,000 years, we can scarcely find a subject upon which our ideas have not materially changed. In the science of medicine we no longer believe that a man can be cured of epilepsy by swallowing the eggs of a snake, or of fever by cutting up the entrails of a frog and taking at intervals. We no longer believe that the quaking of the earth is caused by the imprisoned giants underneath trying to be free; in religion we no longer believe that God is appeased with bloody sacrifices or rich gifts; but it is an interesting fact that on one subject our ideas have not changed in the slightest degree, and that is this: That the farmer, the man who lives in the country, the agriculturist, is, as I just announced, the preserver of our morals, our virtues and our religion. Two thousand years ago the old Emperor Augustus was so much impressed with this fact that he instructed his court body to sing the praises of agriculture. He saw that the old Roman virtues had disappeared, that the virtuous Roman character was no longer to be found there, that manhood was gone and virtue was gone, and he was wise enough to know that these things had been preserved by the sturdy Roman who lived in the country, and he said "sing the praises of the farm; sing of the beauties of nature; sing of the songs of country life and make it so attractive that these subjects of mine will no longer live in towns and cities, but will go back again to the country which was the nurse of all the old Roman virtues." Now, what that old emperor saw was true, is true today; and I want to impress this thought on you, because it seems to me to add a nobility and dignity and value to your calling. I would say to you men gathered here this morning, that you are engaged in an occupation that is not only the basis of the wealth of our nation in a large measure (especially of the middle west), but you are engaged in an occupation that is now and is to be for many, many years the preserver of the purity of our lives, of our morals, the preserver of our religion, the preserver of this republic.

It is one of the bad signs, one of the dangerous signs of the age, to see that our population is gradually drifting away from the farm into the towns and cities. The family from the farm that goes into the city is swallowed up and disappears completely in three years—statistics show that—they are swallowed up and wiped off the face of the earth as completely as if the earth had opened wide its gaping mouth and swallowed them up; but in the country these families endure from generation to generation. Now, I hope each one of you will recognize as never before the importance of your occupation to this country not only in a material way, but from a moral standpoint; and I am sure that when you do recognize this you will be conscious that you are engaged in a calling which is not surpassed in dignity, which is not surpassed in worth, which is not surpassed in value by any occupation in which man is engaged from one end of this mighty land down to the other. It is for this reason—not only because you are engaged in an occupation that forms the basis of our wealth, but that you are engaged in an ocupation that means as well the preserving of the purity of our lives—it is for this reason that I am glad to welcome you to this institution of learning, which has been founded here for that very purpose by the people of this State. We are all co-laborers, and as such we welcome you to this University.

In the name of the faculty and the students of the University of Missouri, I extend to you a most cordial welcome.

ADDRESS OF WELCOME.

(Dr. H. J. Waters, Dean Agricultural College.)

Mr. President, Ladies and Gentlemen:

You will observe by the program that you are to be welcomed here by a number of different people, and on behalf of a number of different classes of people or constituents, and this I take it is because everybody in this community and everybody in this State wants every man or woman who attends this convention to feel absolutely at home here and, as has been pointed out by the President of the University, you are meeting in your own house, in your own building—you are in fact at home; and there is really no necessity for anybody to extend you a welcome to your own palace.

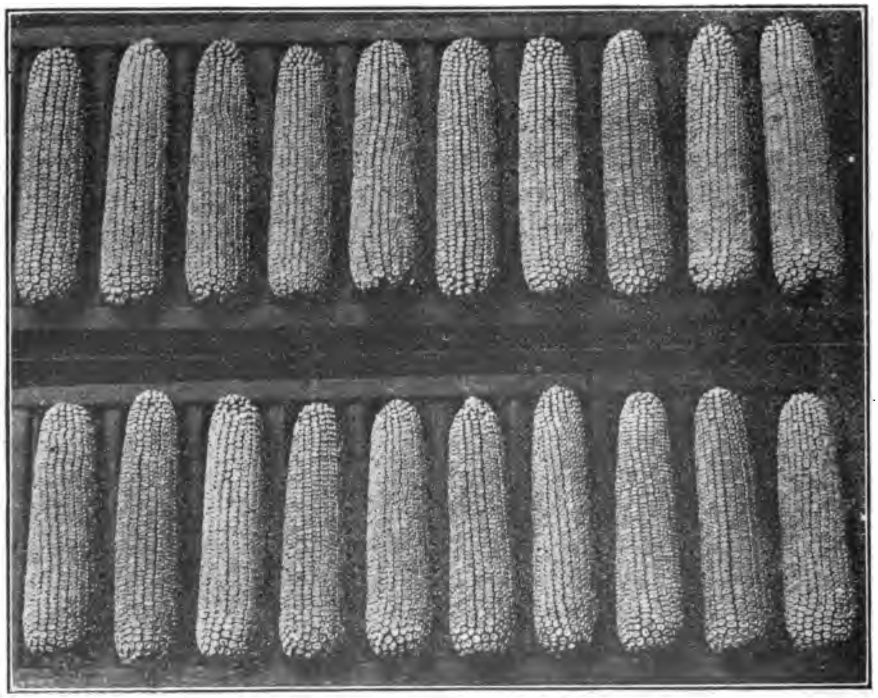
Certainly, if the farmer owns or dominates any part of this institution with which you are this week affiliated, it is the department which has for its special purpose the upbuilding and fostering of your profession; and while in the past the farmer has not felt, perhaps, the interest that he should have in this department, and if he has been disposed to send his sons and daughters into other departments of the University to fit them for other professions, that has been because primarily it was the fashion and the custom for the young men and women on the farm to leave the farm and to go to some one of the so-called learned professions, where it was supposed there were greater opportunities and greater success, and, perhaps, less drudgery; or in other words, it is the old story well illustrated by the answer that was given to a lecturer on social economy when, by way of introduction, he asked "why is it that a married man lives longer than an unmarried man," and some weak, hen-pecked man in the rear of the audience said "they don't—it just seems longer." It is human nature to imagine that the good fishing is all on the other side of the stream, that the romance is all in the other man's life; that trials and troubles and tribulations are all immediately around us; that the landscape far ahead is beautiful, and that immediately before us is full of blemishes and scars and shadows and pitfalls and dangers; but that is not true—it only *seems* so. There is just as much romance in your life as you put there; and how many times have we crossed the stream, perhaps at some peril, to find the water only six inches deep on the other side, while you have left good fishing; and how many young men have left the farm with good opportunities for success and have gone to the cities and towns to find, as the President of the University has so clearly pictured here, only disappointment and ruin in other professions. The truth is today, that there is no other business that offers the certain success that is so free from dangers, moral, financial and physical, as farming. There is no other business that is growing in importanee like farming; no other property enhancing in value like real estate, and no other kind of property that is so valuable; and the Missouri farmer who owns Missouri real estate and makes the mistake of alienating his title to the same, of selling it without immediately buying more of the same, is making a fundamental mistake. I do not believe in the European system of handling the land; but if it were possible (looking at it from a purely selfish standpoint) to prevent that land from going out of the hands of your children, you would be making one of the best possible investments for your family. If you go into any part of

Europe, the only gentleman there is the land owner—he is the man who dominates everything—politically, socially and financially. He is the only man who possesses real wealth; and while agriculture—the ethics of agriculture—our conceptions of the nobility of the calling have not changed in the last two thousand years, as shown by President Jones, yet the practice of agriculture has changed materially and is yet changing, so that the man who was a successful farmer 25 or 30 years ago (unless he has kept busy studying and thinking and progressing) is not a successful farmer today; and while I am certain that the Missouri farmer wears the shirt of a happy man, he at the same time wears the shirt (at least this audience) of a successful corn grower and corn breeder, and those of you who have been in this movement from its beginning will appreciate, when you see that exhibit of corn in the other room, what progress has been made in the last five years in this State. Missouri really began this subject in earnest less than five years ago, and she is now taking the place as a corn breeder that she has so long held as a stock breeder.

Missouri herds have been famous the world over for many years. Ever since Kentucky went out of the business, she handed over to the Missouri farmer that distinguished position; and now it is not to be expected that Illinois will go out of the corn-breeding business, but Illinois will have some good company, now that Missouri has started in the business; and you, gentlemen, who are breeding corn, must earn for Missouri that same reputation that she has for many years held for her live stock; and you will be conferring as great a favor on the State and improving agriculture just as much as the improved live-stock breeder has in the past, and I congratulate you, gentlemen, on the exhibit you are now making. I have seen all of the corn shows held in this country for many years, and there is more improvement manifested here in this exhibit than I have ever seen in that line in the same length of time; and I say I congratulate you; and now I want to say to you, gentlemen, I extend you a hearty welcome on behalf of the Agricultural College. I want you to feel at home, to feel that this is your institution and that you are absolutely urged, and if we can compel you, we will force you to see this department of Agriculture, to meet all of the teachers and the students, and worm out of them all the information you can get; and if you find anything here that does not seem just right, then I want you to say so. I want you to feel that this is your institution, that you are aiding in its development, and that you are behind it, and when we have the farmers behind this institution it is going to suceed; if they are not interested, all the strength that can be put into it from the University side cannot make it a success.

You will find the students of agriculture a live body. I want them to get acqainted with you; I hope you will find the faculty a live body; if not, I want you to stir them up, and I will help you. I hope you will find the Board of Curators a live body; if not, I hope you will stir them up also, and when you make them feel that you, gentlemen, are alive with your importance, then you will have done the College of Agriculture a great deal of good.

I thank you for your presence here and hope it will be an annual event, and that we may come together on such an occasion as this every year.



Sweepstakes, 20-ear Exhibit, State Corn Show, 1906.

SESSION

Missouri Corn Growers' Association

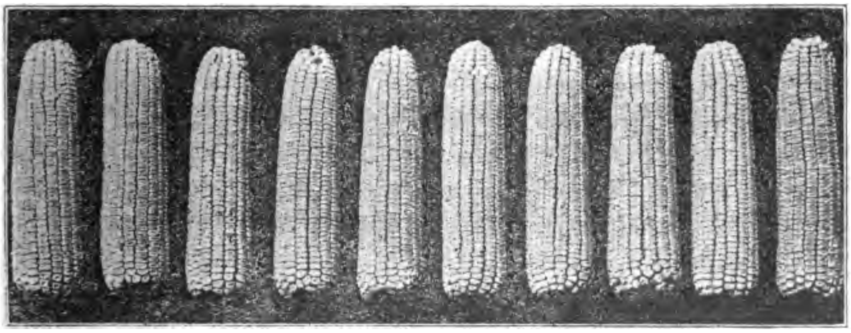
Tuesday, January 9.

PRESIDENT'S ANNUAL ADDRESS.

(E. E. Laughlin, Rich Hill, Mo.)

It is with a degree of self-applause we, the Missouri State Corn Growers' Association, meet in third annual session; applause of victory, still not conquerors, on the field of battle for good corn.

In these campaigns for good corn we find poorly bred samples, which means we must still agitate the doctrine "Missouri Corn," "Increase the Yield," "Improve the Quality."



First prize white corn, State Corn Show, 1906.

To stimulate these local corn shows, the Association this year gave prize ribbons. These shows have been very complimentary to our efforts. These ribbons have put men to thinking and will do much good in the future. As long as farmers are willing to show corn either for prize or honor, there is a chance for improvement. In fact, everyone should be proud of his corn, always ready and willing to show. Else, if we are ashamed, we should discard our present seed stock and adhere to better methods of seed selection and breeding, following closely the propaganda instituted by the Missouri State Corn Growers' Association. These local corn shows should be carried on each year, to keep in touch with improvement or deterioration in seed stock.

Much good literature has been printed for the Association. The Missouri State Board of Agriculture has given us an audience of thousands. On every hand we see and hear the good. Mr. Geo. B. Ellis has been the champion for good corn many years, and has done more for good corn than any other man holding a like position, being tireless to make our Associations successful. Those who were on the institute force three years ago, judging the corn samples for the World's Fair prizes, going over this same territory this year in every case note the great improvement in samples shown.

This movement for good corn is the most rational scheme for higher development in agricultural and live stock improvement ever inaugurated. It costs but three dollars to buy a bushel of good seed corn. When the crop is grown and we feed this well-bred corn to scrub stock, we soon become "sore" on the stock. Thus the round begins that starts good farming with small investment at first; and at last a betterment to the whole. Our leaders in agricultural education are pushing this one subject, corn, knowing well the effect in the future.

The Missouri State Corn Growers' Association score card was first formulated since our last meeting. This is a move in the right direction, as it sets the rule by which we measure samples at corn shows, but more especially in seed selection. Every seed corn grower, particularly the members of this association, should commit to memory these rules. These rules are short and if learned along with the disqualification we can soon select what constitutes a good seed ear and will be more charitable toward it. Those who are the enemies of the score card are generally the casual readers. But as the types develop, the points of scoring can be changed. It is to be assured the score card is the blighting enemy to careless selection. Let every member, one and all, of the Missouri State Corn Growers' Association heartily support this plain simple rule by which corn in all parts of the State can be judged. It is imperative that we outline types prevalent in Missouri. While we have much good corn in the State, still we have a multiplicity of varieties, and as this farm seed problem is new to many in our State, let us say that our present cattle could not have been improved if we had bred promiscuously. Just think, only four beef types are found that are general improvers. While many have tried mixing to get all the good qualities, yet with no future good. We need seed corn types that are as well established as these cattle, that will be as easily told by the average farmer. This can be done. Anyone who ever grew Reid's Yellow Dent can almost tell at a glance the field without the sight of the ear. St. Charles White has its characteristics just as these cattle. But all are not growing these or other pure bred corns but a mixture undoubtedly with a view of improving, as some do in live stock breeding, but in each case failure is the final outcome. Many carry on this breeding under a false conception of the whole and in a few years change seed because of run out qualities. Our great plant breeders cross varieties to get sports. These sports in a majority of cases are very inferior and only one in thousands is equal or superior to the parent plant. We are getting to understand better the laws that have bettered live stock than of years back. It is this: Closer selection in varieties. The deterioration in seed corn is not in in-breeding so much as from faulty selection or out-crossing.

At these corn shows corn has been on exhibition that was in the hands of one grower twenty or more years and is prized as pure, while in these ten ears two or three cobs were of a different color from the class. Indeed, these two red cobs in a sample where the others were white is a poor pedigree of twenty years' standing. The greatest pedigree is in the samples themselves, and uniformity almost to a fault is what all must breed. So if we in the State can have standards, we have gained much. This will benefit the farmer if by pestilence, storm or accident the seed is lost; he will know where to get seed acclimated, whereas if sending north or east several years are lost with getting up the yield or quality settled to his localitv.

Many from other states have bought Missouri corn for seed, but as all Missouri corn is not the same, it is proper for us to get types that can give us a note of standing. Our new members should, in buying seed corn, buy some of the standards that are listed as Missouri corn. So if you wish to make sales of seed corn later, there will be but one standard to advertise—yourself. The classes already outlined embrace almost all the principles of good corn, and, as in all new corn, extravagance is often indulged in which you cannot afford.

Since the organization of the Missouri State Corn Growers' Association, Farmer seed-corn men have become more popular. Ear-corn is taken in preference to shelled with an advance price. Last year one Missouri seed corn grower, from 16 acres, grew two hundred bushels seed ears and sold at two dollars per bushel; but had to return more than a hundred dollars "with regrets, out of seed." There is room for many such in our State, and there is no more lucrative business than raising good well bred seed corn. The Association is ever ready to assist such efforts. While the Association has made an effort to make each corn grower in the State feel he must better his seed for the next year and done much that can never be effaced from the annals of good agriculture, still we have problems that must be solved in the future in a scientific way. Some are storing and testing seed, exterminating of pests, soils and manures in the different phases. All these will come through the proper channel—the Experiment Station. Our station has taken up corn and I am assured more will be done in the future.

Let us all grow well-bred seed corn, each becoming enthusiastic. Study corn from spring till spring. It will expand the mind, it is a clean upbuilding subject—one that we can learn from each year. When we consider we have no really up-to-date corn book in print, that the information has developed so rapidly that past editions have become obsolete, it behooves us all to be on the alert, going over the subject that we may be in the present, farming with the greatest grain crop, the greatest commercial crop Missouri has.

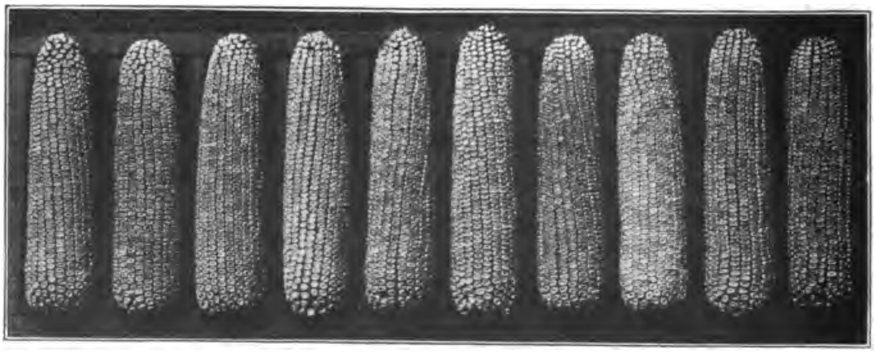
The Missouri State Corn Growers' Association is no experiment, and it stands first among associations for good, and we hope will continue the speed from the impetus received the past three years.

"Missouri Corn"—"Increase the Yield"—"Improve the Quality."

SOME ESSENTIAL FACTORS IN CORN PRODUCTION.

(Dr H. J. Waters, Dean Agricultural College.)

The corn breeders here will discuss one very important and, up to this time, very much neglected factor in corn growing, and that



First prize yellow corn, State Corn Show, 1906.

is the breeding of corn, and I shall therefore not touch upon that, but shall discuss very briefly what might be termed some of the factors in successful corn production, *aside from the seed.*

Feed the Corn to Live Stock.—The most fundamental and most important factor of all is to establish such a system of farming that you will feed every bushel of corn you produce, except what you sell for seed at high prices, to high class stock on your farm. With all the effort and intelligence that the Missouri farmer or corn breeder can put into his business, it will be impossible to produce high and profitable yields on land that is poor; and there is no other very profitable way, as a whole, to keep your land up than by feeding all of the corn and all of the other crops of that sort which you produce on the farm, and so arrange your feeding lots and sheds and racks that the plant food, the droppings from the animals, shall not be carried into the Gulf of Mexico by the first rains that come. It is too often the case that the farmer will not move his manger from one year to another; and you will find a spot there for about one hundred yards around that manger so rich that it will produce nothing, or weeds which are even worse than nothing, while other land in the neighborhood of the manger is starving for food. Then, too, he will put his feed rack on some rocky point that is not worth anything because it is too stony and dry and hot in summer; and in that way there is a prodigious waste of plant food on the farm outside of the selling, even when a man is pursuing this policy of feeding. So this I need only mention as one very important factor in successful corn production—feeding the land continually and keeping up the fertility.

Rotation of Crops—Then I would have a systematic rotation, and this is the first time I think I have ever advised that. I have always advised the contrary; and to the man who would follow the other practice I would say it is undoubtedly better, provided one will put the necessary intelligence into it, but the danger is he will not follow any rotation at all. The Eastern farmer is a slave to rotation, as was his father and his grandfather. It is one of the greatest barriers to progress among the Pennsylvania farmers that they have that rotation on their hands which they cannot abandon. It is as much a part of their traditions as anything else in their whole lives. They will not adopt new methods of production or a new system of farming if it in any way interferes with that rotation. They are in a rut. But the Missouri farmer is sinning or erring in another direction—he has no rotation at all. It would be better, for a while at least, for him to get into the rut of this system of rotation. I would advise a rotation of which clover or cowpeas would be used freely; so freely indeed that every acre of tillable land would be in clover at least once in four years and in timothy as little as possible. That is another very essential factor in the production of corn—grow less timothy and more clover on your land and in your rotation.

Commercial Fertilizers.—It is very doubtful whether or not you can afford a commercial fertilizer on the rich black prairie soil of Northern and Western Missouri. There are other soils, however, naturally thinner, but which produce a good deal of corn, and which, after corn is grown once in two or three years, are left considerably impoverished; and on which, in the absence of a liberal application of barnyard manure, an application of commercial fertilizer might yield a good profit. This does not mean, necessarily, that the increased yield in the corn crop the first year would pay the fertilizer bill and leave a profit; but that before the four or five-year rotation has ended the increased yield of corn, wheat, clover and grass might pay a very good profit on the amount invested in commercial fertilizers. As to just what sort of fertilizer to use, of course, it will depend much upon your soil and its previous treatment, but I believe a reasonable quantity of phosphorus in some cheap form, like finely ground rock and perhaps a small quantity of potash, will pay a profit, provided you will use plenty of clover or barnyard manure, or both, in order to furnish humus to the soil and to supply the nitrogen.

Preparation of the Land—As regards fall and spring plowing, it has been found, as the result of experiments conducted here, and elsewhere, that there is little difference, and that this difference varies so much from season to season, that we may safely say the difference is not so large as the seasonal difference, and that it is more a matter of convenience with the farmer than it is a matter of good or bad policy, provided the land is not rolling enough so that there will be serious loss from washing. In that case, I would not plow in the fall. I should plow late, so as to prevent the soil from running together, and if the land is thin and shallow I would plow deeper in the fall than I would dare to plow in the spring. That is, by throwing up some of the unweathered soil in the fall to be acted upon during the winter you are really accomplishing one of the main beneficial results of plowing. As to depth of plowing, that depends upon the soil. In the spring, as I have just indicated, somewhat shallower plowing should be done than in the fall. We started out a good many years ago with the idea that we should plow deep, and Horace Greeley wrote a book on agriculture, which he dedicated to the man who would invent a plow that would turn the soil to a depth of three feet and cover twenty acres a day. I do not think anyone has yet claimed the dedicatory honors of that book; and we have found that this deep plowing, like subsoiling, makes a good theory and has many theoretical arguments in its favor, but has not been proven practical.

Depth of Planting—The old theory was that in this country, where corn suffers from drought, it is a good idea to plant the corn deep so the roots will be where the moisture is when drought comes. We made some experiments along this line some years ago and found that no benefit whatever was secured by planting the grain deep, as far as the depth of the roots was concerned. They occupied the same area they would have anyhow, and we went to all the expense of putting our corn deep down into the soil and ran a very great risk that it would not come up on account of being put in a soil that is cold and wet, especially if cold, wet weather follows planting, only to get the roots in precisely the same soil area that they would have occupied if planted the normal depth.

Thickness of Planting—This is an old question. Very much will depend on what you are going to do with your corn—more will depend on the soil you have and still more on the season—as to what thickness would give the largest returns. The thinner the land and the drier the season and the larger the corn, the thinner it ought to be planted. The smaller the corn, the richer the land, and the wetter the season, the thicker you should plant. Then the use to which this crop is to be put, i. e., whether to be husked or fed whole, cut up or hogged down, etc., will affect very materially the thickness to plant. There is no question but that one can get a larger number of bushels of corn per acre by planting somewhat thicker than is customary in the average season. By so doing, however, you so reduce the size of the ear, at the same time, of course, increasing the number of ears, that the small increase in yield will be more than offset by the increased labor and cost of husking the same, provided that method of harvesting is to be followed. In such case thinner planting, so as to give good-sized ears, will be best. If one is going to feed it as fodder, ear and all, so as to put it in the silo—and we do a lot of unnecessary work in taking the ear from the stalk and putting it in the crib or pen somewhere and then later uniting stalk and ear again in almost the same proportion—the thick planting will give the larger return. That is, if you are going to feed it as fodder corn you can follow a somewhat thicker planting than you can afford to if you are going to husk it. The proper thickness must be determined by each individual farmer.

The Effect of Suckers on Yield.—In this connection is the matter of suckers which a great many farmers inquire about. The development of suckers is intimately associated with the thickness or completeness of the stand. It is also influenced more or less by the season. The corn plant, so far as we know, was originally a very much branched plant, sending up a number of stalks from one grain, much as wheat and oats yet do. By selection of the largest ear for seed, we have to a very great degree eliminated the branching tendency or the tendency to develop suckers. That is, we have selected the largest ear for seed, which means that we have taken the ear from the stalk that had not branched badly. Among the conditions favoring the development of suckers may be mentioned a very thin stand and a very favorable season for growth. The development of a large number of suckers indicates that you have not a full stand for your land and for the season. Some very interesting experiments along that line have just been reported by the Nebraska Experiment Station, and I will give you figures here showing the influence of the thickness of planting upon the development of suckers.

As an average of several years of experiments—

100 plants, planted four stalks in the hill, developed 8 suckers.
100 plants, three stalks in the hill, produced 25 suckers.
100 pants, two stalks in the hill, developed 76 suckers.
100 plants, one stalk in the hill, produced 198 suckers.

Thus as we progress toward a thinner stand the tendency of the plant to cover the ground completely by the development of those suckers was very manifest.

The question arises what is best to do with those suckers when they are numerous enough to become a menace. For instance, during the time of a drought when the water supply of the soil is drawn upon heavily to develop a crop, these suckers are in the way there just as much as additional stalk would be; indeed, they oftentimes become that. What was originally a sucker becomes another stalk—a little later in coming on it is true—but another stalk with an entire root system. What shall be done with these suckers? Shall they be removed or be allowed to remain? The data and experiments on this point are very limited. Some experiments made at the Nebraska Experiment Station covering three seasons, too short a time for a safe conclusion, indicate that there was no benefit to be derived from the removal of suckers. That is to say, the injury done to the plant in the removing of the sucker was of more consequence than allowing the suckers to stay there. This will need further confirmation, and more experiments will need to be made before we can say that this will be true in the majority of seasons. I should say in passing that some varieties tend much more to produce suckers than do others. The sweet corn, as you all know, has a very great tendency in that direction; flint corn has the same tendency, more or less; dent corn not so much because we have developed it in size by selection.

There are varieties, however, of dent corn that tend much more to suckers than others, and I should discard varieties that tend in that direction.

Corn Tillage.—If we had some way to keep the weeds down one of the chief reasons for tilling would be removed. The functions of tillage for growing a crop like corn are two-fold: First, to keep down the weeds; and second, to conserve the moisture in the soil by preventing the evaporation of the moisture from the surface. A third function that was supposed to be performed by tillage was to stir the soil so the roots could penetrate and develop. If the land has been properly prepared before planting, that third use of tillage does not exist since the soil will be porous enough to permit of the fullest development of the roots. There is no necessity for tilling the land during the growing season to the depth that the roots will grow, and by so doing you are doing your corn, your team and yourself an injury. There is nothing better established in the growing of corn than the fact that root-pruning of corn is a very injurious process to the plant. There is no time in the life of the plant when the roots can be pruned to the benefit of the plant, and there is no time when you can prune those roots without seriously injuring the plant. The drier the season and soil are and the larger the plants, the more injurious the pruning. Growing corn plants require an enormous amount of water, and at the time from tasseling on to maturity they are growing more rapidly than any other plant we know anything about. This means that it needs a greater root system and greater feeding area than it can possibly have if we are stirring that soil up with a cultivator where the roots are in such a way as to cut these roots and at the same time dry out the soil. There is nothing better established in corn growing than the fact that shallow and level tillage will, if you keep the weeds down, produce one season with another a larger yield than will deeptilling or ridged culture. The difficulties in the shallow tilling are two-fold: The difficulty of killing the weeds and still keep the ground level. Many times there is no practical way to kill the weeds except by covering them up, and in that case the land must be ridged. You need some piling of the dirt around the stalks or ridging to a limited amount in order to keep the corn from falling down. You will get enough of that under an ordinary system of tillage without trying particularly to do it. In spite of anything you can do, you will have your land somewhat ridged. As I said before, nothing is better established than the fact that shallow tillage and level ground will produce a larger yield than deep tilling. The main difficulty, however, is that so far we have no entirely successful shallow tillage implements. No one implement nor method nor system will answer for all seasons and circumstances. The safest rule to follow would be to till just as shallow and keep the land just as level as is possible, at the same time seeing that the corn is kept clean and a dust mulch is maintained on the surface to prevent the evaporation of the moisture. To accomplish this most profitably and cheaply will require at one time a very different implement from that required at another time or season. Sometimes the smoothing harrow or an implement like the Hallock weeder will suffice, at other times nothing short of the ordinary cultivator will do.

DISCUSSION.

Mr. ————: Which would you recommend, drilling or planting, so as to cultivate both ways?

Dr. Waters: The experiments thus far made are conflicting on that point, but they indicate that aside from the questions of keeping the corn clean, etc., drilling is preferable. That is, you had better distribute your plants, one in a place, along the row, than to bunch them together.

Mr. ————: In land that is inclined to be wet, isn't it an advantage to hill the corn, throwing up the dirt very high? Won't the advantage that will be to the land in drying it out overcome the advantages in level cultivation?

Dr. Waters: No, not at that season of the year. That is not a season of the year when we suffer from excessive rains.

Mr. ————: I mean for the good of the land afterward.

Dr. Waters: In only very flat lands, yes. Those are limited in Missouri. For very excessive flat lands, that would be the case.

Mr. ————: It would put more life in the land, wouldn't it?

Dr. Waters: Yes, it would aerate the land better. If the land is rolling, it washes badly, and it would be a very serious mistake on that kind of land. The hilling of the land used to be done with the ordinary diamond plow. That has gone out of practice now. It was a bad thing for conserving the moisture. It did not go very deep. That old practice of throwing the soil up, whether the corn needed it or not, was, of course, a bad way to grow corn, and I don't know but that we are fortunate that the diamond plow has gone out of use; but you take some of these other implements in use now, and they throw up as much dirt as the diamond plow, and pile it up unnecessarily. You will remember you have to put that dirt back. You have the labor of throwing it up and throwing it back. You are wasting your effort and your horse-power.

Mr. ————: In a series of years, don't you think we have more trouble with drought than with too much water?

Dr. Waters: Yes.

Mr. White: Would you recommend burning off the ground?

Dr. Waters: No; I would use fire sparingly.

Mr. ————: I would like to ask if any harm can result from turning under the sod in the winter time when very wet? I went over my field a few days ago where the men had not plowed. The sod was wet, and I figured that it would not be dry probably until June, so I turned it under and took my chances.

Dr. Waters: That would depend largely upon the amount of humus in your soil.

Mr. ————: I would like to ask as to the killing of cut-worms by fall powing?

Dr. Waters: You undoubtedy turn them up and freeze them out.

Mr. Wing: I was very much interested in that paper, especially the part which speaks of rotation. I believe you people here are old enough in the business that you will admit that the basic principle of rotation is a good crop of clover. I want to call your attention to our farm in Ohio, which we started about twenty years ago. We tiled and underdrained it first. Then, by growing clover and alfalfa on that land by rotation, we succeeded in growing 80 bushels of corn to the acre, and we did that two years in succession. The first year we got 66 bushels to the acre; then by rotating and putting on a slight spread of manure and sowing it back to corn again, we got 80 bushels to the acre. This was on clay soil. We have grown alfalfa on this field for five or six years. Think we could get four crops of alfalfa a year off that land. We have taken off an average of five tons to the acre during the past five years. I was interested in what Dr. Waters said about tile-draining. We have found that true. They did not seem to draw until we got a lot of manure worked through that land, and after that those tile drains worked first-rate. I just know when I break a field whether it will grow good crops or not. I can tell it the way the blackbirds follow along after me when I drop the corn; and if they don't follow me, I just scratch my head and say I have got to get more humus into that soil.

Mr. Plackmeyer: I plow the ground thoroughly from 7 to 9 inches deep. We plant corn both ways and use the cultivator mostly. We generally plow four or five times and cultivate fairly deep.

Mr. Scott: This is the first time I have attended one of these meetings. Of course, I am simply in the primer class. I am here to learn. I can tell you a little about how we do in our county. We list with two row listers and use five or six horses; and we cultivate the same way. The opinion of our farmers is divided in the matter of listing. Some think they can do better by listing, while others do not. After listing, we follow with the planter. That makes it so your rows are same width apart, and you can use a two-row cultivator to cultivate it. We cultivate first with the disk-harrow and use four horses. We throw the dirt out, away from the corn. This makes a broad place where the sunshine can get in to the corn, and it kills the weeds. We have a small attachment to the disk that stirs up the ground and makes it loose, and we turn right around with that same tool and turn the rows back in. In some parts of Missouri, where the land is not rolling and hilly, you do not need the lister so much, but in our neighborhood we all use it.

Mr. Sly: Mr. Scott and myself are from the same county. Now we list our corn. Some of you don't know what a lister is. It is simply a plow that throws the dirt both ways. In Mr. Scott's part of the county they use a two-row lister, while we use single-row tools. We use the lister in our part of the county almost altogether. We list the ground for planting about four inches deep, throwing up the dirt and making a ridge about eight inches high; we plant the corn in that furrow about two inches deep, which you see will be under the level surface about six inches. We disk twice with the double-disk. We plant our rows about three and a half feet apart. Of course, if you cultivate it more, it is still better. I use a two-horse cultivator; I do that before anything else, and then list it. A good many don't do anything, but I do it to stir the ground up thoroughly; and then it is the cheapest way to raise corn. About the same plan of cultivation is used throughout our county, only some use two-row listers and some single-row listers. We use the cultivator first before anything else and follow with the harrow. Then cultivate it twice afterwards. This plan gets your corn down to a depth where there is no danger of it blowing down. By the time you have your corn laid by, we have ours down in the ground eight or more inches deep. Of course, that would not be practicable in some parts of the State.

Mr. Weeks: I live south of the Missouri river. We follow about the same plan the others have mentioned. We try to do a good deal of cultivation before we plant the corn, and a whole lot afterwards. The most important plowing is the first plowing, because if you leave a strip there not plowed good the first time you will never get the weeds thoroughly cleaned out of that strip; that's the reason I plant corn both ways; I never leave that ridge there. If a man is going to hire any corn plowed, he should hire it plowed the second time and plow it himself the first time. The second time, of course, you generally plow crossways from the first time. I use a steel harrow with slant teeth if the ground is dry. After a hard rain I plow it first—the harrow doesn't do any good. I use a walking cultivator for this reason: I hire a good deal of my plowing done, and have never yet found the man who would get down from the cultivator when riding and remove the clods; some of them will not even use a stick. Several years ago, before I was raising corn for myself, I was raising it for my father. One year I remember the corn was away up here, pretty high, and it got dry and began to burn. Father hired a man, and we had to hitch up the mules to the garden cultivator and go over that corn in that hot weather. I thought it was all foolishness. Thought I knew best. When we got to the end of a row, it was so hot we could hardly get our breath; but the corn that we plowed that way grew right along during the dry weather. But the corn that we did not plow that way all burned up. I believe that is a good idea. Don't stop—just keep right on cultivating. We cannot do just what we always want to do. There is a whole lot in cultivating corn; one of the things is to keep the weeds down; we cannot kill them if they get started; keep them down at the first. This matter of covering up weeds is slow work; they grow as fast as you can cover them up.

Mr. Laughlin: I would like to hear from some one about detasseling corn. Mr. McFarland, do you consider it a success or a failure for a practical farmer?

Mr. McFarland: I find it a very particular thing to do. You have got to go over it every day. If you neglect it a day or so some of it will be in bloom.

Mr. Laughlin: I tried a row this year and found it an absolute failure. It killed the stalk, it seemed to me. I tried it for a couple of weeks without success.

What about storing seed corn? We often find men storing their seed corn in barrels. Has anyone a good plan of storing seed corn?

Mr. Plackmeyer: I have a way of putting it away where the rats will not get to it. I put it in a dry cellar, and have never failed to have a stand yet; it always keeps good and dry and always germinates well.

Mr. Terrill: I have a room in the garret for my corn. I spread it across that room in rows about eight inches apart, and have ventilation from the window.

Mr. Laughlin: I read the other day of a nice plan, where galvanized wire netting was used and put around the crib; that made it mouse proof and at the same time let the air through.

Mr. Weeks: I do not think it makes much difference where you put your seed corn, just so you have it thoroughly dry. It makes no difference how cold it gets, if your corn is thoroughly dry when put away—just so you have a room with a current of air passing through it.

Mr. Johnson: I have a small seed house where I store my seed corn for myself and that which I send out to those who want to buy. I have a door hung on hinges that I can open up when I want to and shut when I want it shut. I have a galvanized wire netting, such as Mr. Laughlin spoke of, to keep the rats and mice away.

Dr. Waters: I would like to ask some of these corn breeders what their experience has been with kiln-dried seed corn?

Prof. Miller: I have been in touch with a great many corn breeders recently and find that nine out of ten do not kiln-dry. They don't seem to know exactly how to do it. You simply keep a stove in the room and keep the air warm. Up in Iowa, in the Agricultural College, I noticed they had an electric fan in the room; but, of course, that would not be practicable for the ordinary farmer.

Mr. Hervy: I think you are getting right down to a practical proposition now when you speak of kiln-drying. You will find that all the leading seed corn breeders practice that method. If you have a furnace you can kiln-dry by the furnace, but if not, use a stove. If you havn't a room, then use the kitchen. Get your corn thoroughly dried out before freezing season, and then keep it above freezing temperature.

Mr. Leffler: Most of you are practical farmers. Now, if there is a way that we can dry this corn, just by ordinary means, by gathering it early and putting it in the barn, or something like that, we would rather get along without this kiln-drying. I have a frame for my seed corn that I hang up in the top of my barn, that is floored. It is suspended so that the rats cannot get to it. I have no trouble about the corn germinating.

Mr. Weeks: I tested several samples last year of corn that I gathered early and placed in a large room in the barn, and took no precautions but to see that there was a good roof on the building, and that the windows were tight; and I kept a window open part of the time so as to have a current of air through the building, and every sample I tested was 98 per cent or over. I took two or three grains from different parts of the ear. If corn is thoroughly dry before freezing sets in in the central part of Missouri, it is all right. It is impossible to keep it above freezing temperature in our section of the country. It got pretty cold there last winter, and went away below zero, but it did not hurt the seed corn.

Mr. Boles: I have a plan of storing my seed corn that has proven successful. I gather a lot of it very early. I have a place up in the eaves of my buggy house where I put it, and it dries out thoroughly. Had left some there for two years, and I tried that, and at least 80 per cent of it came up.

Mr. Crabtree: I have no objection whatever to my seed corn freezing after it is thoroughly dry. I make no attempt whatever to keep my seed corn above freezing temperature, and it always germinates well.

HOW CAN THE PRACTICAL FARMER SECURE GOOD SEED CORN.

(Mr. Geo. H. Sly, Rockport, Mo.)

So much has already been said on corn, the manner of selecting seed, testing, cultivation, etc., that I hardly feel it worth while to attempt to discuss it at any great length. However, I desire to say a few words on "How the Practical Farmer Can Secure Good Seed Corn."

In the first place, we already know that in order to grow a good crop or to grow good stock, we have to have good seed or good stock to start from. In order to get good seed we have to make the best of what we have at hand, get it from a neighbor who may have better than we have, or purchase it from someone who is making a specialty of purebred seed.

The one object we should have in view in growing corn is to grow the greatest number of bushels at the least expense, and in order to do this we must increase the yield per acre, and I consider the seed we use one of the great factors to be used in bringing about such results.

What we want is a corn of high yielding quality and of good feeding value. and to get this we must use the best type of corn that we can get. I believe in a great many instances that farmers already have on their farms corn that will produce greatly increased yields if proper attention be given to the selection of seed. There are two very practical ways by which this can be done. One, by having a seed plot in which each ear is planted in a row by itself; each alternate row being detasseled, so as to cross-fertilize, all barren and undesirable stalks to be cut out.

The other way (and I believe more practical for the farmer) is to select more closely about eight or ten of the very best ears and plant in a square in the field, on the east or southeast side, as it would be less liable to be pollenized from the rest of the field. The seed ought always be tested before planting. There are different ways of doing this, but everyone should have some way of knowing that his corn will grow before planting time.

The manner of planting and cultivation, which differs very materially in different parts of the State, is familiar to everyone, so it is not necessary for me to give it here, only to say, give it the best you possibly can. There is not much danger of giving it too much care. About the time the corn begins to tassel it should be gone over and all barren and undesirable stalks should be cut out—not detasseled, but cut out. It is not good policy to let undesirable stalks absorb the nutrition that should go to develop better corn. It will be necessary to go over it several times to do good work.

Don't undertake too large a square, as it is liable to be neglected.

After the corn is thoroughly matured it should be gathered, and all the best should be put in a good, airy, dry place, free from rats and mice, and either put in racks or not piled very deep, so as to admit of free circulation of air; and get it perfectly dry before freezing weather. The corn should be thoroughly matured before gathering. Except in case of very early corn, I do not believe in our part of the State it should be gathered before about November 1.

If, on the other hand, the farmer does not have the corn he would like to have, then he should go to his neighbor who has good corn, and get seed, or send to some good, reliable seed corn grower and get a small amount of some good variety that has stood the test, has been well bred, and invariably get it in the ear, so you can see what it is.

I would let all so-called new varieties alone, as there are plenty of good, reliable varieties that have been carefully bred, of excellent feeding value, that can be had, and the farmer cannot afford to take the chance of getting something that will prove to be of no value.

But, I believe a better plan, and the plan that farmers will adopt sooner or later (or should adopt, at least), will be to establish corn-breeding farms throughout the State. Let the farmers of a certain locality organize and have some one of their number, who will give corn his particular attention, grow seed for the whole community, the others agreeing to pay a price for the seed sufficient so he can afford to get the best corn available. This, I believe, is the only sure way to keep corn pure. But I fear it will be a hard matter to get the farmers of any given locality to see the benefit of following such a plan, which, in the end, would be of great benefit to everyone.

Let us hope that the farmers of this great commonwealth will profit by the mistakes of the past, work more zealously to bring her agricultural resources to their full capacity, and greater prosperity to all her people.

CORN BREEDING METHODS.

(Hon. J. D. Funk, Bloomington, Ill.)

Gentlemen of Missouri: I was with you about two years ago, I think, at a meeting similar to this; and I want to say that since that time there has been a great improvement in Missouri's State meeting. At that last meeting I attended a few men were gathered together and we discussed problems of great moment among ourselves, and we could talk in whispers and be heard by the entire audience. I can see that this influence for betterment has been exerted by your Agricultural School and by Mr. Ellis; and Missouri, for hundreds of years, cannot pay this institution and this gentleman too high a tribute. They have done a wonderful work. I am very glad to see it. I have attended many other state meetings of a like character to this, and have never seen more intense enthusiasm and interest than is shown here.

To all the well-informed farmers it is quite unnecesary, I am sure, to go into details and explain to you the great strides that have been made by plant breeders of the United States and abroad, or to explain the great work that is being done by such men in America as Hays in Minnesota with his wheat, his variety of wheat, No. 65, I believe it is, that raises six bushels more to the acre by its great power of production than the average wheat in Minnesota; and the great Dr. Weber of the Department of Agriculture, in his breeding of an orange-hybrid, in which he is trying to establish a hardy variety of oranges that will extend the orange belt two or three hundred miles north of the present orange belt. You have all heard of Burbank of California, the wizard of plant-breeding, who has done marvelous things along the line of flowers and fruits. He is making wonderful progress in the development of plants. You are all familiar with his work, I know. But let me impress this fact upon you, that plant breeding in America will bring further and more diversified benefits, comforts and more prosperity to the American people, and humanity in general, than steam or electricity has ever produced. We are only beginning to understand the vast possibilities of plant breeding. We are only dampening our feet in the great sea of knowledge. We know very little about it, and what we do know places us in somewhat the same position as were the mariners who sailed with Columbus, who, when they returned to Spain, knew that they had struck land; but that was about all they knew; they knew nothing of the continent discovered. And the plant breeders of America have struck land. We know we can do something, and something useful, but where it is going to lead to, we don't know. It is unknown as yet. I want to say to the American farmer that there is no question that they should get closer to than plant breeding. They should learn all they can about the principles of plant breeding, especially the breeding of cereals. And to the farmers of the Mississippi Valley, I will say that nothing stands them in hand so much as to get close to corn breeding. I heard it said here this morning that corn was the backbone of your finances; it furnishes 50 per cent of your annual income. By acquainting yourself with corn breeding, you make it possible to increase that income.

When I speak of corn breeding, I do not refer to novel or odd developments of certain characteristics of the corn plant. Corn breeding with us means, as an ultimate result, utility. Utility resolves itself at once into the great question of yield. Corn is not sold over the dry goods counter—it does not have to be pretty; it does not have to appeal to the esthetic taste. We want quantity and quality. The breeder must take this into consideration first; 90 per cent of his selection depends upon yield. I say 90 per cent; that is simply approximate. But yield must be his greatest aim. Of course, he must note the position of the ear on the stalk, the standing ability of the corn plant and a few other points, but yield is the great question.

There are two influences in all nature—two principles, life principles. One is the external life principle; that is, the environments surrounding a certain individual from infancy to maturity, from the embryo to maturity. The other principle is the inherent life principle. The corn *grower* should deal exclusively with the external life principle. He should leave the inherent life principle to the corn ***breeder***. We cannot all be corn breeders. It would not be profitable for us all to be corn breeders, but we can all have a knowledge of it, and this knowledge will help each and every farmer in America in selecting his seed. But the corn breeder should deal only with the inherent life principle—by that I mean the influences exerted by the past generations on the next progeny or rather the coming generation. The first step of the corn breeder is to establish the breeding block. Next he must make his selection of ears. Let us take, for instance, a man who has determined to make his life-work corn breeding; he has mapped that out for himself; he has only one place to start, and that is at the beginning. He has to make his selection of mother ears. He selects them to the best of his knowledge; say he selects 100 of them. He next plants them in rows in his breeding block, of say, three to five acres in extent, each row representing a mother ear. He knows the rows and he knows the ears, and he sets them down in his record. Ear No. 1 is planted in Row No. 1, and so on. He makes as complete a record of this mother ear as he can. There are a great many things he could say about her that are needless. What he is after is what that ear is going to do in the way of yield, not what it looks like so much, only as a reference when he is selecting the progeny from that ear. Well, he plants his 100 ears, and during the season of growth he must take notes as to germination. He must know the germination. Let me impress this on you—(all the corn breeders here know it, but there may be some laymen among you)—that weakness and strength are just as inherent in corn as they are in live stock. Poor germination is inherent. Germination is not affected so much by its inheritance as it is by poor curing, or poor storage, but it is inherent, and he must take into account the germination that every mother row makes. He must take into account the growth of that mother ear, the growth of that whole row. He must take notes all during the growing season as to its vigor of growth, as to its amount of foliage, as to its standing ability, as to the placement of the ears; in short, all characteristics that he cannot get at the harvest time. He must have every mother ear on the same amount of ground; now that's a hard thing to do. He must make his rows of equal length, and must ascertain at harvest time the amount of ground taken up by each mother ear. He must count his stalks and his hills and ears. He must weigh his entire row, and then he will find corn production per stalk and average weight of ear; they are two different things. He can compute from these the approximate yield per acre that each mother ear makes. That must be his basis for selection the first year, taking the other items into consideration that I have spoken of. From this row that proves to be the grand champion of the block, and from several other rows, say eight or ten, that are the highest yielders in the block (we may call them the eight or ten champion rows), rows that have made the tests and are qualified for champions, he must select his breeding ears for the next year. He plants these again in his breeding block.

Now, when he has planted his first year's breeding block, he should save about four rows of corn on the cob of each mother ear. I would suggest two rows from each side. The saving of this corn on the mother ear is very important, because the next year he must plant the remnants of the eight or ten champion ears in a small breeding plot; he mates them together. In this way he brings together the champions and crosses them—and when I say he crosses them, I do not mean he breeds from one variety to another, but he, of course, keeps within the variety. Corn is an open fertilized plant; it thrives under that condition; under crossing, if you please. That's the nature of it. Now, I don't say that in-breeding is disastrous to corn—that is, confining the family—but I do say that in-breeding to the extent of self-fertilization is very disastrous in corn. By self-fertilization I mean the falling of the pollen from the same stalk on to the silk produced by that stock. I think under that sort of fertilization your corn soon retrogrades.

Now, in crossing, these ten mother ears that you have identified as champions in production and other qualities, make five pairs, mating two individuals together, and use one of the two ears that you mate the next year as a sire; use the other as a dam. To use it as a dam you have to detassel it. Let me illustrate this a little. Say ears No. 1 and 50 prove to be the best champions in your breeding block; they have been high in standing ability, and placement of ear has been right, and foliage right, and yield the most. Plant ear No. 1 as your sire in the odd rows; leave the tassels on it. Plant ear No. 50 in the even rows and detassel it. Then, using ear No. 50 as your dam and ear No. 1 as your sire, save all your breeding corn of these two champions from your detasseled corn from your even rows. They will not be self-fertilized. You have eliminated the liability of that disastrous effect of self-fertilization. You can be sure on that point at least—that all of your corn has been fertilized from an ear that we know has proven to be a champion, both as to yield and all these other qualifications. Then take your breeding ears from your even rows and confine the family. Breed it in a block by itself. Now, after you select eight or ten mother ears and cross them in this way, you will select breeding ears from four good mother ears of two years before. Do you see what I mean? You will cut your selection down to only one-half of the number of champion ears that you had in 1904. In 1904 you proved these ten mother ears; in 1905 you mated these ten mother ears that were champions; and in 1905, when it came to selection time, you cut that number in two and only saved five of them, the five used as dams, and in a small field—say 20 acres—make five different plots, and plant your four ears that were used as dams. This is in 1906. Plant your five ears that were used as dams in 1905, and propagate for more seed. From ear No. 50 of 1904, referred to before, plant as large plots as you have good breeding ears out of the small plot of 1905. Now you are crossing here. Guard against self-fertilization. In-breeding to the extent of second cousins is not disastrous; this has been demontrated. But detasseling your even rows in these blocks, or if you have not time to detassel all the even rows in that 20 acres, detassel some in each plot, enough so that you can select seed for your general fields. Here again you must keep track of the amount you plant from one strain of corn. This is now a strain of corn, bred from ear No. 50. It has been bred for three years. Save seed from that, if it proves to be the best yielder in the block. Select it from detasseled rows. Go through it the last of September or the first of October and select considerable of the seed from the standing stalks and hang it up in the top of the seedhouse, where it will get good ventilation and dry out early; and it will be all right there if the weather does not get to 28 or 30 degrees below zero. It may absorb some moisture previous to the cold, and if so, it will have damaged kernels. Here again apply the old test; the second time we must prove our dam; we must prove that she is champion in all respects. Then again, if you can get enough seed in one strain to plant all the rest of your farm, so much the better. If not, then select from two or even four of your plots. Now in your small breeding block in 1905, in mating these ears, you have to identify the power of production in these strains; then you have to control the influence exerted on the progeny; you have to control the influence in both parents, in both the sire and dam. In 1905 the sire has proved himself to be a champion ear; but there are individual differences in these odd rows, and they may vary greatly. There is nothing in nature that varies like corn, and if it were not for that variation, corn breeding would be impossible, because it is on account of that variation that we have the great opportunity for selection. These individual plants used as sires vary up and down, and we take the ones that vary up if we can. By *up* I mean they produce better characteristics. There will be variations in these even rows, and you cannot tell whether this ear produced on an odd row of corn that looks to you to be the best of the block—you cannot tell whether she has been fertilized from a poor individual or a good one; you don't know whether the influence is for good or bad; so you must resort to the most technical practice in corn breeding. This is the real work of the corn breeder. He must control the influence of the sire and the dam and he must be able to identify that influence. Now, he must handpollinate ears in these odd rows from individual stalks in the even rows. To perform this task you cap the ear before the silks appear and also cap the tassel before the pollen commences to fly; and you take the pollen from the capped tassel and apply it to the silk of the capped ear. Call the capped tassel plant No. 1 and call the capped ear plant No. 2. Now you know that the sire of ear No. 2 is plant No. 1. You know exactly what kind of an ear this plant produces; you know what it has done; you know the influence that is going to be exerted on the progeny. You can count on what these kernels will bring forth. You cannot perform this fertilization as well as nature can, but you can tell what will be the general conformation of ear, whether she will be a good one or not. You will have to use discrimination in this, but it is very seldom that you will do the work as well as Nature. You will have to make different pollinizations three or four times, say two days apart, about the last of July or the first of August, usually the first of August; most all the pollen flies at that period.

There are million of grains of pollen produced on a little bit of tassel, and this is so fine that you can hardly see it. You must fertilize a good many of these ears from even rows onto odd rows. You cannot tell what will be a good sire or dam; you must make a good many crosses and you will hit it in some of them, and when you do, you have an ear of corn worth any other 500 bushels on your farm. When you find an ear that has been fertilized by a plant that has a breeding ear on it, and that ear is a breeding ear in itself and they both came from champion rows, proven to be champions in yield and other qualifications, you have an invaluable ear if you intend to farm any longer than that year or long enough to get enough corn from that ear to plant your farm.

DISCUSSION.

Mr. Wing: How far out should the silks be?

Mr. Funk: You should get to them just as soon as you can after they appear.

Mr. Wing: Do you think heredity has anything to do with kernel selection?

Mr. Funk: No, I don't. Every one of these kernels inherits a likeness of the dam. You must take the ear as a unit. The sires may have been good, but their influence upon the dam is imparted to everyone equally, and in this kernel selection you are going to have to know the sire to make an intelligent selection.

Mr. Wing: Don't you think the influence of the sire would be manifest the first year to some extent in the growth of that kernel?

Mr. Funk: Oh, yes, certainly.

Dr. Waters: How do you tell when you have made that crossing a success? How do you know when you have got a good thing?

Mr. Funk: The only way we know is by breeding it down. We know we have the influence of the sire here because this ear was fertilized from a plant that produced a big ear. Now, when you are trying to improve the ear, what do you do in the corn field? You simply increase the average size of ear. You raise the production of corn per stalk. That is the only way you can increase your yield—that is, by plant breeding.

Dr. Waters: You take all these ears you have proved to be champions and grow them in plots next year?

Mr. Funk: Not all of them. We eliminate a part to start with; 95 per cent of our work is lost; but that is the only way we can get the influence of a good sire on to a good dam.

Dr. Waters: Let me ask you further—in your selection and in your breeding work, how much importance do you attach to the conformation of the ear itself?

Mr. Funk: I am sorry you asked that question. The score card is an excellent thing, and it is going to serve a great purpose, and has served a great purpose already, but I don't pay one bit of attention to the score card when I select my breeding ears. It is what the ear has done that I am after. It is the inherent value and not the apparent value. Now don't misunderstand me. You must have capacity ears. By capacity I mean store house room on the cob for the corn. You must have that; but I don't pay any attention to the rest of the score card. But as a commercial breeder of corn I have to for this reason: That if I send you seed corn and the rows are all twisted and look as if the kernels had been put on with a shot gun, you say "what are you sending me?" It is not so much what you ought to have as what you want; so I have to pay some attention to it myself. Now I have got a strain No. 99, bred from the Reid corn, a very smooth corn like the old-fashioned Reid corn. Now, we are not trying to breed a smooth corn because it does not give you the capacity that a rough corn does. I mean a surplus seed coat. When you have a smooth corn your seed coat is filled up; you have no surplus of seed coat. Now, your corn fills this kernel up full, and when your season of drying comes on, it is maintained to some extent; it becomes rough. You have a surplus of seed coat. I always try to select a seed coat with roughness on it.

Dr. Waters: Do you find in your breeding that the tendency towards flintiness is associated with a tendency towards shallowness of grain, and that the tendency towards roughness is liable to be associated with deepness of grain?

Mr. Funk: Yes, with some exceptions. But as a general thing, that holds true—that in smooth corn there is a shallow kernel, while in rough corn there is a longer kernel; but there are exceptions to that.

Mr. Weeks: After you get a strain started, and get enough seed to plant the whole farm, you have got to plant that with a planter, and if you don't have good ears of that strain you will not get uniform results.

Mr. Funk: That's a great point. One of the greatest points of utility. One of the greatest points with a strain would be its uniformity, not only of the ears, but of the kernels. Just as long as we have to plant corn mechanically by a planter, we have to have corn that will drop kernels as much alike in size and shape as we can get them; that is, for uniformity.

Mr. ————: Do you recommend the grading machine?

Mr. Funk: Yes, I do.

Mr. Weeks: Doesn't the season have something to do with the size of the cob?

Mr. Funk: I rather doubt it. It may have something to do with the length of your kernel—soil and season both; but as to the size of your cob, it may have, I don't know.

Mr. Weeks: I find that the seed corn taken from high land and that taken from bottom land—the same strain invariably has a larger cob on the bottom land than on the high land.

Mr. Funk: Is that so? I didn't know that.

Mr. Crabtree: Do you find it to be a fact that in producing an excessively large cob that so much longer season is required to do that?

Mr. Funk: If it is the nature of your corn to have a large cob, that corn will be of a later maturity. I would like to grow a corn that will take all my season and no more to mature thoroughly—just take all that season and get ripe; and then I want as big an ear as I can grow, as much kernel as I can grow.

Dr. Waters: How much stress in your breeding do you lay upon proportion of grain on the cob? Do you insist on the ears having a very high percentage of grain? I mean, suppose you have an ear of corn that you think will make a mother ear? Say it was a big ear, but did not have quite as high a percentage of corn to the cob as you would like, but had other things in its favor. Would you discard that for an ear that had a high percentage of corn to cob, but did not have so many other points in its favor?

Mr. Funk: No, I would not. I would have a line, of course, but would not consider those that had the other points over-balanced.

Mr. ————: You have been breeding corn for *quantity*; now have you been breeding it for *quality?*

Mr. Funk: Yes, we have fertilized everyone of our mother ears both for oil and for protein. Now I am not talking about mating of mother ears. We have what we call a protein block and an oil block of certain varieties of corn, and in one of them we strive for oil properties and in the other for protein properties. Whether it will be practical or not, we do not know. Of course, we feed all of our cattle upon corn we think best adapted for feeding value. The normal percentage of oil in corn, I believe, is about 4 1-4, and of protein 10 1-4. We have strains that average in the plot—taking a five or ten-acre plot and making a selection of five or eight hundred ears out of the block—13.1 protein and 5.56 oil. Now the German balanced ration has about 13 1-2 per cent protein; but I do not think that is the balanced ration in corn, because I know if we feed such corn to hogs they will not grow with that thrift that they should have. They will fatten, but not with the thrift they should have. Now, whether crude oil is more fattening than carbo-hydrates, I don't know. About 80 per cent is carbo-hydrates. Whether the crude oil has a tendency to overcome so much of the protein, I don't know. I hope to produce a corn sometime that three bushels of it will go as far towards fattening and finishing cattle as four bushels of the common corn does now. I think it can be done.

Mr. Crabtree: Do you think it wise to produce a balanced ration in corn rather than to feed the corn for its oil and balance that ration with protein?

Mr. Funk: I think high oil is better than high protein. There is nothing that will feed like corn oil unless it is more corn oil.

THE GERMINATION TEST.

(C. O. Raine, Canton, Mo.)

Having made a proper selection of seed, a crate is made of some light material, so as to be easily handled, and should be about 20 inches square, with an inch frame around the side. Cover this with a heavy piece of paper, over which place a white cloth, marked into 100 sections or squares, and dampen well before using. These sections will be sufficiently large to hold 6 or 8 grains each. The work of placing the corn in the crate is begun with ear No. 1, by catching the ear with one hand, and with the knife (always use the back of the knife) remove two grains each from the butt, middle and tip and place in section No. 1. This operation is repeated until crate one is filled. Now cover this with a piece of muslin and dampen well to hold seed in position; this should be covered with a heavier cloth, such as will retain moisture, and over this place a heavy piece of paper, or such material as will retain heat and moisture. During germination the crate should be kept in a room of even temperature, or as nearly so as practicable. It would be well to dampen the crate each day, as the moisture evaporates rapidly, and when not given due attention the results due from neglect at this time will be quite disappointing. From 8 to 10 days will be necessary to test each crate. In some instances the center or sides are the last to show signs of life; this will depend largely on the amount of heat given the center or the lack of moisture at the sides.

The judging of the test is one of interest and requires that we examine closely each grain, as it will be found that the butts, the middle or tips of some ears will test well, while the rest of the ear will be unfit for use. This defect can hardly be detected before putting to the test, as from all outward appearances the grain is sound, and this, no doubt, in many instances is the cause of a poor stand of corn. Again, it will be found that some ears are slow to germinate and are weak and appear to be as much inclined to grow down as up, and what is meant by this? That after the seed has started a day or two the vitality of the plant is arrested, and it seems to be battling with nature for existence. All such seed should be discarded, as in most cases, unless under very favorable climatic conditions at the time of planting, the plant would make a slow growth and produce a light crop of very inferior quality. In discusing this subject, some of the results perhaps would be admissible.

From a test of 1,400 ears it was found that a fraction of over one-half of one per cent was unfit to be used in planting. This was of the Leaming variety of late planting, but well matured. It made a vigorous growth from the start and maintained itself in good order throughout the season. From a test of 900 ears of the Reid's variety fully 50 per cent was thrown out of one lot, and from the lot retained for planting a very poor stand was secured, not sufficient to replant, making it necesary to plant again, causing a delay of from 6 to 10 days. From a third lot in which a test of less than 2 per cent was thrown out of the last named variety and planted the same time as test No. 2, a uniform stand was secured and produced about 50 bushels per acre of good, marketable corn, while that of lot No. 2 gave only about 30 bushels of a very inferior quality. It must not be inferred that because the seed germinates that it will do to plant, as it often occurs that the root germ will make a vigorous growth, while the stalk germ will be weak and often will cease to grow after the first two or three days. It would be well to plant only those ears that make a vigorous growth from the start, as when the seed is placed in the earth nature will not nourish it so gently as when under cover in a room of even temperature.

GROWING CORN IN THE OZARKS.

(Mr. E. O. Weeks, Eldon, Missouri.)

I have lived on a farm all my life, and I have raised a crop of corn every year but 1901; I made a mistake that year; I had in ten acres of corn and hired a couple of men to take care of it; and the first night they went home they took every ear in the field. If I had harvested it myself, would have saved the crop, but as it was, I lost it.

Up until the winter of 1903 I had thought all there was to growing corn was to plow and plant and plow, but that year, in January, 1903, I went to an Agricultural College to take a short course in live stock judging, as I was becoming interested in the breeding of pure-bred stock. Well, after I had been there for a day or two, I kind of lost out on the stock judging and became interested in the corn judging business. I got interested in the most interesting subject there; the more a man studied it the more he wants to learn of it. After I had been home for a few days I was very much surprised to get notice from the College that I had won first prize for the best corn judging. Until that time I had never seen a good ear of corn; had never seen an ear of pure-bred corn. The next spring I purchased some pure-bred seed, and the three years since that time I know I have increased my yield 30 per cent with the same land, same cultivation and same strain of corn; possibly I gave it a little better cultivation, as I was more interested; I think we all do that; the more we know about a subject the more pains we will take in it. In estimating the crop, I am positive I have averaged 30 per cent more corn during the last three years than any preceding three years I have been growing corn. Up until 1903, I never raised over 40 bushels to the acre. Now, I wish to say here, that I do not farm river bottom land. But the last three crops I have raised I have measured parts of the field, weighed the corn, and estimated the whole field carefully, and I am satisfied that I have made an average of 60 bushels to the acre for the entire three years. I haul all of my manure on to the land I intend to plow for corn; then I put in the corn, and follow the corn with oats, and as soon as I thresh the oats I start to plow for wheat; and after the wheat I put in clover and timothy; and I am satisfied that it is a practical plan, and that all my crops are getting better. Last year I had ten acres in corn, and it made over 60 bushels to the acre. This year I threshed even 250 sacks of oats from the same ten acres. It is now in wheat and looks very favorable. I have used commercial fertilizers on wheat alone—never on corn or oats; have used it on wheat alone for five years, and I know that in that five years I have saved enough grass seed—that is, I have had a stand of grass, clover and timothy, every year for the last five years; and before that time I lost enough grass seed during the same number of years to pay for all the fertilizers I have ever used, and I have made an average of 25 bushels of wheat for every acre grown since using fertilizers.

I always try to plant my corn as soon as the ground gets right and the weather gets right. This year I knew the ground was right and thought the weather was right, but I was mistaken. I never planted corn any nicer than I did that. I fall-plowed the sod, worked it up loose, disked it, harrowed it, and planted the corn in good shape; well, for three weeks it stayed in just the condition I planted it; but after a while it began to come up and got a very fair start. I thought then that I was all right. But one day I went out and thought that there was something working on that corn, but did not think much about it then. I went out the next day and knew there was something working on that corn. I had 45 acres of it, and before I got over that 45 acres I was getting excited. I soon saw that worms were working on that corn; I sent some of them to Professor Miller and he turned them over to Professor Stedman and he wrote me he did not think there was much cause for anxiety. The next day I started after the worms; started after them hard; and in a few days after I got his letter the worms were all gone. So you see what that letter did. However, I think there is a little moral to that.

I have made it a rule in growing corn never to wait until the conditions get just right; if you do, something is going to happen. There is an old man down in our county who says the conditions are never just right except when he is gone to dinner—too wet in the forenoon and too dry in the afternoon. The best thing to do is to do the best you can and get everything as near right as you can. Why, here is the ground, the soil and the weather and a whole outfit of signs; and then the moon and the sun, and, of course, the farmer, to get ready; and if they all get ready at the same time, things are quite likely to result the wrong way.

This last spring I planted 50 rows from individual ears and made a record of the ears; I got quite a lot of figures and became very much interested. I picked out the best fifty ears that I had—those I thought were the best. I find we must not rank our seed too high; they will not all be perfect. Next year I will breed ears from the rows that produced the most corn this year. And if those ears again next year produce the champion rows, then I will begin to think I am getting started in a good line of breeding and that I am going in the right direction. I have kept a record. Ears No. 7 or 8 had 22 rows. I thought that every ear in that row would have 22 rows; but they had the same number of rows that the general crop had—from 18 to 24; and I began to study that a little more; saw it was not possible unless the whole patch had been planted for several years with ears of 22 rows; because it is impossible not to get a cross fertilization in there from ears that had more than 22 rows; and even if that was the case, it would probably breed back and get some ears with a different number of rows.

I made a mistake last year, cutting my corn too soon. Had been used to cutting my corn by hand. I always began just as soon as I could and put up half shocks; had to do this or it would get too dry; but this year I used a corn harvester with four mules. If you are not careful you will get up too large shocks in a bundle. We had very wet weather and the corn damaged considerable. I think it is a great mistake to start to cut too soon; I am satisfied I would have been many dollars ahead if I had waited until later to cut my corn.

DISCUSSION.

Mr. Henderson: Has any one present tried a four years' rotation of corn, wheat, clover and timothy. We do not find it a very profitable one in this section of the State; the objection being that we have to plant our wheat after corn, and cannot always get the ground in proper condition after cutting our corn. I would also like to ask what kind of fertilizer has been found best suited for this section when putting in wheat?

Mr. Smith: I will tell you some of my experience. In 1900, the dry year, was my first experience in raising wheat on corn land. I went in with my disk harrow in the spring and disked the ground, giving it a double disking; and on the 14th of September I sowed 40 acres of wheat. When I harvested that 40 acres I got 28 bushels to the acre on land which it was said would not grow wheat; then I planted that 40 acres to wheat again. The best wheat crops I have gotten have been on corn land. This year I have 385 acres of wheat growing and half of it is on corn land, and is looking fine.

Mr. Boles: I want to emphasize one point which Mr. Weeks made in his talk. He said that after he came back from school he felt as if he took more interest in the cultivation of corn than he did before he went. Now, the point is this: the more knowledge we have of a thing the more interest we take in it, and that's the secret of the whole business, to take an interest. If we learn what corn is good and what is not, then we will not plant the scrub corn. And this will hold good in everything. I will say to these students, the more you know about a thing the more useful it will be to you.

Mr. Laughlin: How do you cut your corn?

Mr. Weeks: I set the binder to tie as small as possible, about one dozen stalks to the bundle.

Mr. Laughlin: How many stalks do you put in a bundle?

Mr. Weeks: That depends on condition of corn at time of cutting; if it is green, cut smaller bundles than if dry.

Mr. Laughlin: How do you shock your corn with these binders?

Mr. Weeks: I used the binder this year for the first time, I shredded the fodder. Taking everything into consideration, you can get the fodder ready to shred much cheaper. This is not an expensive way to cut corn.

Mr. Laughlin: I have a jack twelve feet long with the legs bolted on; an open place is left in the center, and you can put in about 20 bundles. You will have to tie the bundles or they will fall down when you pull that jack out.

Mr. ————: I would like to ask if you can cut ten or twelve acres a day with one binder?

Mr. Weeks: I have never tried it a whole day at a time; but I have cut about eight acres in three-fourths of a day, using four mules.

Mr. ————: I have had some experience with a corn binder for cutting fodder. A great many men object to the expensiveness of this manner of cutting corn; and I thought at first when I began using the binder that it was as expensive as the old-fashioned way of cutting with the corn knife; but this year it was too muddy to cut corn on my farm with a binder; and I was driven to the necessity of employing men and cutting it by hand; it cost me about $35 to cut my corn this year by hand and set it up, and I know that it was poorly done. It should not have cost me over seven or eight dollars (barring cost of team and binder) to have harvested that corn with the binder.

Mr. ———: I have found in the past seven years of my experience that corn can easily be cared for either by holding it a week or having it placed in shocks; it will keep. I have rotated for the most part with four-year rotations, following corn stubble with wheat. I only use corn on the same land one year at a time; and owing to the fact that in past years it has been very difficult to get help to cut my corn by hand, I have bought a binder; was very much dissatisfied with the work at first, but after becoming acquainted with it and understanding better how to handle it and regulate the size of bundles, and taking into consideration the fact that I cut my corn in such a way that the stubble is mostly out of the way in preparing the land for wheat, I concluded it was the cheapest way in which I could remove the corn for the purpose of sowing wheat. It is true that some ears are knocked off once in a while, but they are gathered and fed at once.

Mr. ———: How many bushels to the acre do you knock off?

Mr. ———: If corn is taken too green, a great deal is knocked off, but if it is just right, it would probably knock off from three to four bushels. That was my experience. I have been following this four-year rotation ever since 1881; the first time I knew of it in the spring I put in a crop of oats. After that time I did not attempt to sow oats after corn stubble, except in a very limited way. I follow my corn stubble with wheat and sow timothy and clover in the spring. I never have used any fertilizers. Have had crops of wheat all the way from practically nothing up to 40 odd bushels to the acre. I find that much depends on the character of the preparation of the soil. I never plow my corn stubble. I always disk it thoroughly, and after I am through (unlike a great many of the farmers) I always harrow; and I have experimented along that line and think I see an advantage in harrowing after the drill.

Mr. Sly: Some farmers think it cheaper to cut by hand than with harvester. I think the corn harvester is away ahead. It is not always the expense you must consider. It is the condition you get it done in. With the harvester you can cut it in a few days, when by hand it will take so long you can not get it done in as good condition.. The plan Mr. Laughlin spoke of could not be used in our part of the State because, unless you put up very large shocks, the snow blows in that open space in the winter.

THE PRACTICAL SIDE OF CORN IMPROVEMENT.

(P. E. Crabtree, Hannon, Mo)

It would seem, from what we have heard this afternoon and the interest taken in the discussions that followed various talks on this corn question, that there would be nothing left to say at this time. However, in assigning this subject at this time, it appears (at least the management thought) there would be something to be said particularly along the line of the practical side of corn improvement that has remained unsaid. After listening to the subject as handled, I feel that it is next to impossible for me to handle this subject without overlapping or encroaching somewhat on the subjects of speakers who have gone before me. However, I shall endeavor to carry out this part of the program.

Mr. Ellis has told you that the addition of two grains to the ear of the corn production of Missouri at the present time would amount in increased yield to a valuation of $200,000. I will say that that will be most easily reached—that we can entirely surpass that point, and I will call your attention to one thing (it applies to the majority of the corn that we produce at the present time) that will save many times two grains per ear: That one thing being simply the matter of having more solid, firmly set corn on the ear. Where is the farmer who can handle his corn without wasting—dropping or shelling off—an average of more than two grains per ear? That is noticeable in some of the varieties in particular that we handle. I will say that in institute work, in which I have assisted to some extent this fall, I have noticed some varieties that shell very easily that have been on exhibition. One of them which I recall now is the Cartner corn; a very pretty tapering corn, but very loose on the ear and has to be handled very carefully in order to make a creditable show on exhibition. If we can add to the value of the corn crop of Missouri so much money in excess of the $200,000 per year in that one way, what must we be able to add to it in the various ways that are outlined and that will in future be outlined in the matter of practical corn production?

The farmer is interested very largely in the matter of the amount of shelled corn that he is able to produce per acre. It might suggest itself to one person that a large grain would be a very good thing perhaps; to another, that a large ear was a good thing; to still another (who hasn't given the matter much thought), that a particularly large stalk was a desirable trait of character in this plant. Those things, the most of them, have been given due thought, I believe, by the various corn associations throughout the corn belt, and they have come to an opinion in regard to those various requirements of the corn plant. How closely those opinions agree is one of the important things that we might wish to learn. I believe it will be interesting for me to read to you from this chart which I have prepared outlining differences in the score card for corn, gotten out by the Agricultural Experiment Stations for the states of Ohio, Nebraska and our own State, compared one with the other.

UNIFORMITY.

Ohio ....15 Missouri......................10 Nebraska...........................5

SHAPE AND SIZE OF KERNEL.

Ohio ....15 Missouri......................10 Nebraska...........................5

MATURITY AND SEED CONDITION.

Ohio ....15 Missouri......................15 Nebraska...........................5

(Notice how regularly it is making an entire diversity of 300 per cent.)

SPACE BETWEEN ROWS AND BETWEEN KERNELS IN THE ROW.

Ohio ....10 Missouri......................5 Nebraska...........................5

COLOR GRAIN AND COB.

Ohio ....10 Missouri......................10 Nebraska...........................10

(The only thing the three agree on.)

UNIFORMITY OF KERNEL.

Ohio ....5 Missouri......................10 Nebraska...........................5

LENGTH OF EAR.

Ohio ....10 Missouri...................... Nebraska...........................10

CIRCUMFERENCE.

Ohio ....5 Missouri...................... Nebraska...........................5

BUTTS.

Ohio ....5 Missouri......................10 Nebraska...........................5

TIPS.

Ohio ....5 Missouri......................5 Nebraska...........................10

PER CENT OF GRAIN.

Ohio ....5 Missouri......................15 Nebraska...........................20

(Total difference in extremes of 400 per cent.)

Now the thing that comes up before the class of people we have present at this time is this: We need to make an exhibit ear of corn to command all those states. Almost all of the judges who have had considerable experience in the different states all agree upon the individual ear or individual exhibit as being the best one. Then, if that is true, and this is the measure, the basis of our consideration, for those specific requirements, are we not up to that point where we could well afford to devote some time, even considerable time, to the matter of allotting a number of points to those different requirements that would be a little more nearly uniform with each other; otherwise I think they are somewhat misleading. I think work in that line should be carried on by the practical farmer—the man who raises corn for sale by the bushel. I think, to, that a little more detailed work on that line in the experimenting on the requirements of the score card would be a good line of work to follow out. "Now," one might say, "wherein do those differences exist?" I will say further I believe there are good reasons in some instances for differences existing, and those are differences in location, soil and climate. I think with those differences we can well afford to have a difference in the requirements of the score card; but while all that is true, I think we should adopt some recognized type of corn and let each of the other types fall in the class in which they belong. I not only believe that to be true as a breeder of corn and as an exhibitor of corn, but I believe it to be true from what I have seen in the holding of these county shows in connection with institute work. It is hard for me to convince a man who lives in the river bottoms and raises that type of corn and says he can raise a larger crop of that corn than by adopting the present corn standard. They will not believe me. They will back up their disbelief by doubting whether there is very much in recognized effort in the line of corn production and still further by remaining away from the corn show. I find the majority of them on upland soil find it more practicable to produce a medium type of corn, not especially large, but a medium-sized ear of corn with good shelling proportions, about 84 to 86 per cent, and would object very seriously to coming down to what I would prefer to call the northern type of corn, which has splendid shelling proportions, has a very small cob, and they tell me, in a majority of localities, is a splendid producer. I firmly believe that producing capacity is the first, and marketable condition the second consideration.

And it is to those people we must look for the production of wealth in the way of raising corn in our corn belt. How can we convince these farmers in the river bottom? Can we make some arrangement through which they will raise the type best suited to their section and not have to compete against the type of corn that is more profitably produced on the upland corn ground of the State?

Now, in all the various breeds of corn, and varieties of corn, we should recognize in each and every one a difference in the manner in which it should be produced, and that each person on his farm select the kind of corn and produce it, in size of ear, type of grain, and all those things that go to make up an ear of corn; let him have his pleasure in regard to that and yet have the stimulus which is afforded by competing in our corn shows and winning some of those premiums which he cannot hope to win when his type must compete against another type.

Further along that line I will say that there is something more practical in the matter of corn production than the majority of farmers understand. When the farmer undertakes to plant his corn in an up-to-date manner, he has trouble to exceed over 86 or 87 per cent; he cannot do it. He cannot secure uniformity of grain; and if a farmer should undertake to shell seed corn from this, I don't think he could shell but a small quantity a day—perhaps two or three gallons. This matter of creating a personal seed corn may not be in reach of all farmers. I believe it is a good thing, but as I surely believe you can take an ear of corn with uniformity of grain represented here (holding up an ear), and that all of the enterprising farmers and the ones who are extremely hard to advise can raise corn similar to that in uniformity of grain. I do believe, as a farmer, that we have got to get this matter of corn showing down to where we can get in touch with the farmer. I believe, also, that if we can show him that there are some varieties of corn in which there is exhibited a great deal of waste space, that the rows on the ears stand widely apart and there is a loss of space, loss in weight, and invariably a larger proportion of cob than is necessary simply because the cob does not carry enough corn, I believe he can understand that. By the way, there are some things which they don't at present understand. Some time ago on my return home from an institute meeting, a German who lives near me said, "I would like to show you my seed corn; I understand you are interested in corn." I went with him to his corn crib, where he had the husks stripped up and hung on poles, and he picked out this ear (holding up a very large ear), and he said that was a fine big ear. "Don't you believe," he said, "that the larger the ear the bigger crop you can raise?" I told him I would be glad to take that ear with me. I had never seen an ear that exhibited more of the irregularities from a practical point of view than that one ear—in regard to shelling proportions and extreme size of cob. You have tried, no doubt, many a time after damp weather and then freezing weather following, to husk such an ear of corn, and you find it impossible to break such a shank. Those are practical features. I believe these matters are pretty well understood generally, but I find some who do not understand them.

Now in regard to some of the fads carried out in corn production. I believe too often has it been the case that producing an extremely high shelling proportion of corn to the ear has led the corn fancier away from practical lines. Among the sixteen kinds of corn with which I have experimented here is one kind (holding up an ear), called "Farmers' Favorite." The ambition of the person who introduced this type was to produce the highest possible shelling proportion of corn to ear. When that corn is planted it always stands in an inclined position, and any unfavorable weather in the way of a damp morning that corn would lean over so badly that in cultivation you would break off many of the stalks; also, in cultivation, if you injured it the least bit, it would invaribly turn so that in cultivating your field going the other way, you were sure to injure it again. Consequently before you are through with it you have a very poor stand.

Another thing: Here is a sample of another corn (holding up an ear). See the lost space in it; it has a shaky tendency on the cob. Those things are to be considered in the line of the work that corn breeders and fanciers have to carry out. In the majority of localities I find that the medium-sized ear, the grains tightly and well set on a medium-sized cob, is what most breeders consider a practical thing—a corn that sets well together, when loosened at one end still remains compact on the ear. It seems to be the concensus of opinion among the various persons who have experimented along the line, that such a corn will not shell badly; when you pull off a handful of it and then hand the ear all around, the grains will still stay on the cob. I have mentioned those things in leading up to another point. I suggested that I believe that a general corn standard that all of these types might somewhat nearly approach would be a good thing to be adopted.

If we should subdivide corn, for the purpose of exhibiting it, for the purpose of interesting all the corn growers, into three divisions, my preference would be to call one kind—the quick maturing kind, moderately small—Northern type; the kind most people would raise I would call Central type; and the slowly maturing corn the Southern type. That is only a matter of distinction between the three, a distinction people would readily take to and understand. I am going to say something that some of you will criticise. When a man criticises a thing you have got him interested and got him to thinking, and if he can think to a purpose, if he is criticising something, he will let somebody else know about it, and this will result in good in the long run.. I would not advocate making any particular variety of corn for the Northern, or for the Central or Southern type. I would let a person take St. Charles White, or anything else, and if he found he could produce the best crop on his land by a manner of planting, or which he would demonstrate to be the best in regard to stand, let him do it with an eye single to those conditions and not have to have one eye, or both, on whether he was raising a variety that would be permitted to enter the show.

Gentlemen, when we have reached that point, we have reached a practical point that will get almost every farmer in the country to exhibit his corn.

What would be the requirements of those different types of corn in making the basis of classification? My notion is this: The size for the Northern type would be 6x8 inches; Central 7 1-2x10 inches; Southern, 8 1-4x11 inches. I would favor making a shelling test of the Southern type 80 per cent, the ordinary market standard. I would make the Central type 84 per cent, and the Northern type 86 per cent. Then you can show the farmer why he can compete in the show, and you can also show him that he will not be dissatisfied when the rewards are made. I firmly believe, gentlemen, that when you have got everybody who is interested in the growing of corn deeply interested in how to produce a larger crop per acre, you have solved the most serious problem that can confront the farmer of the corn belt.

*THE USE OF THE SCORE CARD IN JUDGING CORN.

(M. F. Miller, Professor of Agronomy, Agricultural College.)

The value of the score card in judging corn lies largely in the fact that it calls attention to those characters which go to make up an ideal ear. With practice it also makes possible a more accurate comparison of samples. In the hands of the average farmer it is of greatest value in teaching the good and bad points in ears of corn, thus enabling him to select the proper ears for seed. At local corn shows it serves a most important purpose in directing the judgment of those passing upon the samples and in fixing the attention of exhibitors on the characters in which particular samples may excel or may be lacking.

At the last meeting of the Missouri Corn Growers' Association a committee was appointed to revise the score card previously used, since experiments had indicated that certain slight changes were necessary. The changes consist, first, in giving somewhat more emphasis to the uniformity of exhibit, since if corn is to represent a type and show careful selection, the ears must be alike in every way. Second, the character of the germ had not been mentioned in the old score card, and since it is the purpose of the score card to give us better seed corn, it was thought best to give more attention to this character. The score card here presented is a revision as suggested by this committee, and will be used as the official score card of the Association for the coming year. For the most accurate comparison of samples, it is evident that in corn, as in animals, each breed variety should have its own score card, but as this association has not yet adopted any particular varieties as standard for Missouri, then it is necessary to continue to use a general score card for

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*Prof. Miller gave a demonstration in corn judging, but this paper is printed in its place.

judging all varieties. It will be noticed that this arrangement of points, while maintaining certain ideals as to character of ears, allows of such a general use.

MISSOURI SCORE CARD FOR CORN.

Uniformity of exhibit	15
Maturity and market condition	10
Purity (as shown by color):	
Of kernels	5
Of cob	5
Shape of ear	10
Proportion of length and circumference	10
Shape and uniformity of kernels	10
Character of germ	10
Butts	5
Tips	5
Space between rows	5
Per cent of corn to ear	10

DIRECTIONS FOR USING THE SCORE CARD.

Samples of corn should consist of 10 ears each, and for convenience in judging they should be laid on tables or boards so that the ears of each particular exhibit lie side by side for comparison. This allows of a much more careful examination than where the ears are piled. Blocks of wood may be placed between the different samples, or nails may be driven in slightly at either side of the exhibit to hold it in place.

In scoring it is usually simpler to add the number of points cut under each subhead and then subtract the total from 100 than it is to make the subtractions separately. An exhibit cutting the full number of points under any one head should be thrown out.

UNIFORMITY OF EXHIBIT (15).

The importance of uniformity of exhibit is recognized in the fact that in well-bred corn a particular type must be maintained, and the nearer the ears look alike the better breeding they show. The ears of an exhibit should be uniform in size, color and indentation. Judge the exhibit separately for each of these characters. The 15 points will allow 5 to be given to size, 5 to color and 5 to indentation; or in other words, each ear will be allowed one half point under each of these heads.

For each ear that is larger or smaller than the prevailing type, cut one half point. For each ear that shows a different shade of color from the prevailing type, cut one half point. For each ear differing in indentation from the prevailing type, that is, if it is either rougher or smoother in the grain, cut one half point. Add these cuts together for total cut of uniformity of exhibit.

MATURITY AND MARKET CONDITION (10).

It is realized that maturity is not so important in corn grown in this State, especially the southern half, as it is in regions farther north, since seasons are usually long enough to mature even the later varieties. However, corn planted late and for this reason failing to mature will be low in germinating power, and this is to be avoided. Ears should be solid and free from injury or decayed spots. To determine the maturity, twist the individual ears in the hands. Each ear showing a marked degree of looseness should be cut 1 point. For ears less imperfect in this respect a cut of one-half point should be allowed. Corn is expected to be dry when shown, and judges usually assume that if corn is not dry it is immature. If early in the fall, some allowance must be made, and the judge must use discretion in this matter. Ears showing rotten spots or injuries should be cut from one-fourth to one-half point each.

PURITY.

Well-bred corn must be free from mixture with any other variety; consequently a serious mixture in kernels or a variation in color of cobs cannot be tolerated.

A. KERNELS (5).

Kernels should be free from mixture with corn of the opposite color. In yellow corn the mixture is shown on the caps of the kernels, in white corn on the sides. For each kernel in an ear showing such a mixture cut one-fourth point. Five ears, cutting 1 point each for mixture of kernels, shall bar the exhibit, except in mixed corn, where this is not considered.

B. COBS (5).

Cobs should be of one color; in yellow corn they are usually red and in white corn white, although there are exceptions to this rule, such as the St. Charles White, which has a red cob. For each cob opposite in color from the prevailing type cut 2 points. For pink cobs cut one-fourth to one-half point, according to the shade of color. Two cobs of opposite color shall bar the exhibit. This is not considered in mixed corn, except in such varieties as run true to type, such as Calico, Bloody Butcher and Red.

SHAPE OF EAR (10).

Ears should be as nearly cylindrical as possible, unless it is a recognized characteristic of the ears of the particular variety under consideration to be tapering. A cylindrical ear usually means a greater per cent of corn to cob and a larger number of kernels of uniform size and shape for planting. (Leaming is quite tapering, Reid's Yellow Dent is slightly tapering, Boone Co. White, Silver Mine and St. Charles White are nearly cyclindrical.) Cut one-half point for each ear that tapers too greatly.

PROPORTION OF LENGTH AND CIRCUMFERENCE (10).

It is believed that the highest yield of corn per acre will be gotten from ears having a ratio of circumference to length approximately 3 to 4, or the circumference measured at a point one-third the distance from butt to tip should be three-fourths the length. Ears that are too short and thick, or ears too long and slim, are to be avoided. A ten-inch ear should be approximately seven and one-half inches in circumference. A tape line should be used in making these measurements, although a little practice will enable one to judge accurately with the eye. It is recognized that in the southern part of the State corn grows larger than in the northern part of the State, and the same is true of rich lands as compared with thin lands. The same variety will vary some under these different conditions. No definite rules can therefore be laid down regarding the size of ears of any variety when considering the State as a whole.

SHAPE AND UNIFORMITY OF KERNELS (10).

The shape and uniformity of kernels is a very important consideration. The kernels of the whole exhibit must be uniform in size and shape in order to allow of accurate dropping by the planter. The most ideal type of kernel is one slightly wedge-shaped but not pointed, the length of which is approximately 1 1-2 times as great as the width at the widest part. They should have a good thickness carried evenly the length of the kernel and they should be sufficiently wide at the tip to allow of a good development of germ. Remove three kernels from one side of each ear near the middle, laying them at the end of the ear for comparison. For each ear showing kernels of poor shape, or kernels which are larger or smaller than the prevailing type, cut 1 point. Should an ear have kernels deficient in both uniformity and shape, cut the ear 2 points.

CHARACTER OF GERM (10).

An inspection of the germ of a kernel of corn will give a fairly accurate indication of its germinating power. For strong germination, the germs should be full, smooth and bright, not blistered, shrivelled or discolored. When split with a knife or broken open, they should show a fresh, brittle, oily appearance. Cut 1 point for each ear showing germs decidedly defective.

BUTTS (5).

An ideal butt on an ear of corn should be well rounded out with deep, regular kernels solidly and evenly compacted together around a clean, cup shape cavity. The attachment to the stalk for medium varieties should be three-fourths of an inch, or about one inch between the edge of the kernels. The ears should break off clean, leaving no adhering parts on the shanks. Well-bred corn is indicated very readily by the character of the butts, since these are readily changed by careful selection. Cut not to exceed one-half point for each defective butt.

TIPS (5).

There should be deep kernels well out to the end of the ear in as regular rows as possible. The ideal tip is completely covered, but if the kernels are deep and regular out even with the end of the cob, no cut need be given. It is realized that the character of the tip is affected largely by season, although selection is an important factor in securing perfect tips. If undue attention is given to covered tips, however, neglecting the proportions of the ear, the result is usually seen in a greater number of short ears, since it is usually the short ear which has the best tip. Cut one-half point for each tip seriously defective.

SPACE BETWEEN ROWS (5).

Furrows between rows should be narrow. It is not necessary that they fit perfectly tight together, but there should be no great amount of open space. Cut not to exceed one-half point for each ear seriously defective in this respect.

PER CENT OF CORN TO EAR (10).

The per cent of corn to ear should not be under 84. Recent experiments seem to indicate that a high per cent of corn to ear does not necessarily mean a high yield of shelled corn per acre; consequently too much emphasis should not be laid on the property of individual ears to shell a high per cent of corn. What is wanted is a large yield of shelled corn per acre, and indications point toward the possibility of this being more easily secured with cobs of fair size than with smaller cobs. The per cent of corn to ear is best determined by selling every other ear of an exhibit and weighing, or it may be done with a fair degree of accuracy by shelling two representative ears. Ordinarily, where the corn is to be preserved, this per cent can be determined with sufficient accuracy by noting the depth of kernel and the weight of ear in the hand. Cut not to exceed one point for each ear markedly deficient in this respect, or where the ears are shelled and weighed, cut 1 1-2 points for each per cent which the sample averages below 85.

THE MOST PROFITABLE TYPES OF CORN FOR MISSOURI FARMERS.

(Col. G. W. Waters, Canton, Mo.)

The average Missouri farmer is vastly more interested in a type of corn that will yield largely than in one that will score high on the show tables. He has not studied to discriminate as to the lower feeding values of different corns, as indicated in the varying protein, oil or starch content, but looks only to the bushels of sound shelled corn that any given variety will produce. This is his measure of value, his standard of excellence. And in this he is right. Seek first a maximum yielding corn, and all the other subsidiary requirements may in time be added by judicious breeding.

The question then is, what style, size, shape of ear, sort of stalk and blades, what period of maturity and what general characteristics are identical with the best average yielding corn? I have watched the results in the growth of a great number of types of corn, in length of ear all the way from the "Long John," twelve to fourteen inches long, to the thick, short mastodon in size, from the Giant Normandy, Boone County White, and other extra large sorts to the Cartner, and other smaller varieties. As to size of grain, I have carefully observed from the large broad grain of the Hickory King to Shoepeg; as to number of rows to the ear from the eight-rowed to 30 or even 32 rows; and as to one ear to the stalk, or many ears, as is the so-called "Prolific" sorts; and I conclude that the medium, between the extremes, gives the best average results.

I come to this conclusion first upon the safe theory of the "survival of the fittest." Since I can first remember, at frequent intervals the extreme types have been introduced and tried, but fully 80 per cent of the farmers have swung round to the use of the medium sizes and one ear to the stalk. J. O. Roberts of Clarksville, who has had a wide and varied experience in raising and handling corn, as a farmer on rich bottom land, on medium land and on hill or high upland, also as a miller for a long period, and thirdly as a dealer buying corn from thousands of crops, said to the writer, "After all, the most satisfactory kind for all kinds of land and all kinds of seasons, and the safest to plant is a medium-sized white corn."

To be more specific, ten inches long should be the maximum. This would mean that a very large percentage of ears grown on average land would fall short of that from one to two inches. The ratio of three to four for circumference to length remains unchallenged. The size of the kernels is of some importance. Having measured many hundreds of samples of high producing crops, I would prefer the following dimensions: Length of grain, one-half inch to nine-sixteenths; width of grain, five and a half sixteenths; thickness of grain, two and a half sixteenths. The shape of grain should be key stone, as nearly straight on edges as possible, thus filling all the space. The rows should extend three-sixteenths of an inch beyond the cob at the butt, and to within three-sixteenths of an inch of end at tip. The evident result of closely fitting, solid, deep grains, and the extension at the butt is to get the greatest amount of corn possible on a cob of a given size. The reason I would not encourage the extension of grains to the extreme tip of the cob is that at this point is the most hazardous place to grow corn. It is subject to all the vicissitudes and damages of weather, birds and insects, and energy expended in growing grains at the extreme tip is more often than otherwise lost. The only way to guard and protect it is to have the corn shortened so that the shuck will cover it completely. If the size of the ear and the size of the grain are both to be maintained, then it follows that a uniform number of rows must be established. I have found that eighteen rows gives grains about the right size on ears of normal size. Very large, broad grains, as a rule, are rounded and do not fit closely on the cob. On the other hand, the sharp-pointed grain carries too small a germ for strong germinating powers. Thin, flat grains are objectionable from the same cause. A medium thick grain, carrying a deep, large germ, is the better yielding type.

Having outlined an ideal type of corn that any farmer can produce, let us see what it would mean in bushels of corn planted by check row, three feet eight inches would have 3240 hills to the acre. Two stalks to the hill, each stalk bearing a ten-inch ear would mean over ninety bushels to the acre. I say over ninety, for I have weighed hundreds of sample ears, and they will average over one pound each, and if well filled and matured, will shell out one hundred bushels. What does the farmer want with bigger corn than that? But let us drop to nine inches in length and to 14 ounces each, and we get right close to eighty bushels. Eight-inch ears should weigh 12 ounces, and that would mean sixey-seven bushels. But suppose we try raising nubbins weighing only eight ounces each and get 45 bushels to the acre, and we are then five bushels above the maximum average yield of the State for any one year in her history, and fifty per cent above our ten-year average. It is evident then that our weak point in corn production is not want of size of ears, but want of uniformity. It is safer and easier to get uniformity in the smaller and medium types than in the large. I once got a package of corn from Washington called the "Giant Normandy." I gave it a good trial. The ears varied in size from two ounces to two pounds. It had no redeeming trait; in fact, it was a sport without any prepotency toward uniformity. If the Missouri farmer could procure a strain of corn with fixed prepotency to such a degree that every stalk would produce an ear, even a ten-ounce ear, it would beat anything he has now. I repeat, the great need of today is uniformity in productivity. This trait may be bred into the corn by selecting from the rows producing the greatest number of ears of a uniform size. The idea of selecting the abnormal in size is only aggravating the evil.

Uniformity in ear development can only be had from uniform stalk growth. We often notice great divergence in size and form of stalks all growing along under apparently the same favorable conditions; some small and spindling and others low and stocky. These differences may be due to one of two causes; first, inherent tendency to variation for lack of fixedness of type, or it may be due, as Mr. Holden contends, to variable vitality in seed planted. The spindling dwarf or runty stalks might be the result of weakened seed, but the abnormally tall stalks and the tendency to barrenness is more apt to be inherent. In either case, uniformity of grain from typical, uniform stalks, grain strong in germinating power to be had by using grain of good size with full, healthy germ, is a means of securing uniform stand and uniform production. In my judgment it would be well if the farmers would discard the greater majority of various types now in use and use only two varieties, one of white and one of yellow. Or if for feeding purposes only, then one variety is enough. We are relying too much on far-off and much advertised sorts, and not enough on our own ability to modify our own corn to suit our own conditions as to climate, soil, etc. In the foregoing I have described what I deem to be the most profitable type of corn for Missouri, leaving it to the judgment of the reader to determine which of the varieties now in use best fills the bill.

Wishing the Missouri Corn Growers' Association much success and commending their earnest work, I respectfully submit this paper.

STRONG VITALITY IN SEED CORN—HOW TO GET IT.

(Hon. E. D. Funk, Bloomington, Ill.)

I will tell you how we gather our seed corn, and the different methods we have tried. I will tell you how the government is performing an experiment which extends over a period of about five or six years on our farm—an experiment of the time of gathering seed corn and the nature of storing seed corn. I will also tell you what the authorities at Washington, after a three years' experiment, have decided is the proper way to store seed corn.

We gather our seed corn as early as possible, but, of course, the time depends on the season. We gather just as long as we can before a hard storm sets in; a rain, followed by a hard freeze, or something of that sort, prevents the further gathering of seed corn. We generally expose that seed corn to a natural ventilation, a natural circulation of the air; or perhaps, we have such a constructed seed house that the ventilation will be forced. You can readily construct a seed house of that sort yourself by making a series of doors along the sides, place your seed house well up from the ground; and then putting in the cone of the roof especially constructed windows. We use kiln-drying windows, which create a suction up; these are used in kiln-drying houses; and you know that if kiln-dried corn ever becomes dampened again, it is spoiled; consequently there must be a supply of hot air all the time—no moist air can come in. The corn that is gathered about the first of October and stored either in crates, or loosely thrown in, in such a seed house, or hung up on a series of wires along the roof of the seed house, is the very best germinating corn I know of.

Now, we attempt to dry the corn as rapidly as possible; we attempt to drive off all the moisture; and then to keep the seed house at a temperature of a uniform heat, usually kept 35 degrees above zero. During the winter there are cold snaps where the thermometer will go down to 20 degrees below zero; and we have had instances where corn will absorb moisture, and a freeze will follow, and the germination is lowered and the vitality is hurt very greatly. We have kept our seed houses at such a temperature during those cold snaps that there is no danger of any such results. We have had differently constructed seed houses; we have tried forced ventilation, and circulation without artificial heat, and we find it does not give us as good results as when we keep the temperature above that very low point. I should say we should not let the temperature get below 10 above zero. Now, in our work, I don't know of an instance where it has gotten below 20 degrees above, but 10 degrees is low enough for the danger point.

The government have selected what they call four stations on the farm—one being an open crib, two artificially heated seed houses and one the old type of seed house—that is, the seed house without the artificial heat. They have taken three varieties of corn. They start gathering about the middle of September; they have a man who does no other kind of work on the farm but this; he gathers twice a week. They have a half bushel of each variety for each station. After gathering, the man in charge takes a sample of corn he gathers at that time and also a sample of corn gathered previously, and sends these samples in sealed bottles to Washington, where they are analyzed and the moisture content is taken and the germination is taken at that time. You can see that as the season advances this work increases, because he has to take a sample of each gathering he has made previously. Consequently, at the end of the season, which last year was about the middle of January, this work means a great deal, takes up all the man's time in taking these samples and sending them to Washington. This year they only made one gathering a week and stopped gathering the middle of December. I will try and give you a few of the results from these different gatherings.

The germination of the open crib for the gathering up to the 20th of December was 92 per cent; 94 per cent for the seed house without heat, and 96.8 for the heated seed house. The corn gathered in September did not germinate as well as the corn gathered in October; neither did the corn gathered in December germinate as well as the corn gathered either in October or September. After about the middle of January we received our first blow from the north; it turned very cold, 28 degrees below zero. At that point, the germination in the open crib dropped to 64 per cent; the germination in the unheated seed house dropped to 86 per cent, and the germination in the heated seed house increased to 97 per cent; the germination in the heated seed house remained practically fixed—just as good after the hard freeze as before.

They have registering thermometers in all these stations, giving the temperature every hour of the day. The registering thermometer in the seed house without heat went to 24 degrees below zero. In other words, that cold snap brought the germination in the open crib from 92 to 68, in the unheated seed house from 94 to 86, and the germination in the heated seed house remained the same. Now they took ten gatherings from these different varieties at the four stations and planted them in plots, the gathering extending from the middle of September to the middle of January. In the field the difference in germination was more noticeable than it was in the germination at Washington. Not only was the germination of the open crib very poor, but the vigor with which the corn grew that did sprout was very poor—it lacked vigor and color and strength, and the germination in some of the rows from the open crib went as low as 6 per cent—practically killed it all. The heated seed houses germinated about 94 and the unheated seed house germinated about 80. They are going to continue this experiment, and the data they get later on will be more valuable. I think, however, it will result just about the same as it has. I think the heated seed houses are essential, but I think that the temperature of the corn should not be allowed to drop below 10 or 20 degrees above zero. Mr. Hartley, in a paper read before the American Corn Breeders' Association last year, made this statement: That from the kiln-dried corn (this experiment extends over a period of three years), they received a yield exceeding the natural dried corn over 15 bushels per acre; that is, the kiln-dried corn yielded 15 bushels more per acre than the natural dried corn. Now, I don't know whether he kept the temperature up above the freezing point or not, but that was the statement he made.

Now, for the ordinary farmer, I think the best method for him to gather his seed corn is to go out early and pick a few ears that are of the proper size and of the right uniformity, and hang them up above the driveway in the barn, where they will get all the ventilation possible, and before damaging weather comes on place them in the house. You can put them in the house some place where they will be out of the way and where the temperature will be kept normal.

DISCUSSION.

Mr. ———: What about that kiln-dried corn yielding 15 bushels more to the acre than the natural dried corn? What was the reason for that?

Mr. Funk: The vitality is stronger and germination more spontaneous.

Mr. Wing: Do you think there is such a thing as getting it too dry?

Mr. Funk: I think you can apply too much heat, but you can't get your corn too dry. You know No. 2 corn is dry corn, and the per cent of moisture in No. 2 corn is from 12 to 14 per cent. Now, when we analyze our sample of corn, we always take the moisture test. Of course, that which has been dried merely by hanging up on racks, the moisture content will run as low as 5 to 10 per cent, or below what they would call dry corn on the market.

Mr. Funk: I wish some of you would tell me how you dry your corn here.

Mr. ————: We, in Missouri, have always thought the open crib did pretty well, but if kiln-drying adds so much to the yield, why we would prefer that plan.

Mr. Funk: I did not say that it would.

Mr. ————: Do you believe it?

Mr. Funk: We should believe everything that Washington says, of course, but we may have our doubts just the same. I think Mr. Hartley is undoubtedly sincere in his statement, and I think that has been his result, but I think he should continue the experiment longer.

Mr. ————: Have you ever tried to carry corn over from one year to another; does that damage the vatility,

Mr. Funk: Yes. The germination is lower; and in two-year-old corn it is still worse. We have tried five-year old corn, and the germination is about 6 or 10 per cent, starting with the germination of 95 to 98 per cent.

Mr. ————: How had it been kept?

Mr. Funk: In an unheated seed house; germination continued to drop through the period of five years until it got to 6 per cent.

Mr. ————: I knew a man who had some corn 17 years old that germinated.

Mr. Funk: He must have had an awfully vigorous corn in the first place.

Mr. Sly: I would like to say that in 1904 I planted two bushels of corn grown in 1901, and had a good stand; made 80 bushels to the acre; it had just been kept in the barn in sacks.

Mr. Funk: Of course, we all know that there are times when we have to plant at least one-year old corn, and I think it is safe to do so sometimes; but I would not follow it as a practice; I would try to plant new corn, unless very much afraid of its germination.

Mr. ————: Do you test every ear?

Mr. Funk: No, not with the germinator. But would certainly test it. We test every ear we plant ourselves, but we don't test all of the seed corn we send out. We test the corn in composite samples from each and every lot that is brought into the seed house.

Corn deteriorates very rapidly when shelled, and we have had some very sad experiences in shelling corn too early. It absorbs moisture more readily shelled, and if very cold weather follows, the germination is very low.

Mr. Wing: While on the subject of corn and the good it does to kiln-dry it, I will say that my average yield of natural dried corn was 25 to 40 bushels per acre. Well, I kiln-dried it last winter, hung it up in the barn and it got very dry (that is why I asked if it could get too dry). I grew alfalfa on my corn land for four years and spread manure on it and plowed it up and planted kiln-dried corn, and had 100 bushels to the acre on some of it, and an average of 75 bushels over the whole field. So it seems that kiln-drying made an increase of about 40 bushels to the acre. Now, something else about corn. I have been wondering whether you are right about growing only one ear on the stalk, because down in South Carolina they grow four to nine ears on the stalk. You need not laugh at that; because the actual yield on one measured acre of land was 240 bushels—10 bushels to the shock. I knew the man who planted it and there can be no doubt about it.

RESOLUTIONS

Adopted at the Third Annual Meeting of the Missouri State Corn Growers' Association.

I. Resolved, That it is the desire of this Association to extend to the citizens of Columbia a vote of thanks for their cordial welcome and for the hospitality extended to us.

II. Resolved, That we express our hearty appreciation of the aid which the Legislature has given the corn growers of the State, through the Agricultural Experiment Station and State Board of Agriculture, and we respectfully ask that these appropriations be continued. We also wish to commend most heartily the untiring efforts of the members of the State Board of Agriculture and the faculty of the Agricultural College in bringing the farmers of the State to realize the necessity for improving the corn crop, pledging at the same time our earnest co-operation in this work in any way possible.

III. Resolved, That in as much as the farming conditions are so different in various parts of the State, we respectfully ask the Experiment Station to establish branch experimental farms in as many districts as possible for the study of the soil and crop problem.

IV. Resolved, That in as much as the closing of any foreign ports to our meat products directly affects the corn growers, let us respectfully ask our representatives in the National Congress of the United States to use their strongest influence in establishing reciprocal relations with all foreign countries regarding the keeping open of their ports to our animal products.

Soil Session.

Wednesday, January 10.

RESTORING THE FERTILITY OF A RUN-DOWN FARM.

(Dr. Chas. E. Thorne, Director Ohio Experiment Station, Worcester, O.)

I.

Astronomers tell us that the earth was once a red-hot, molten mass, surrounded by an atmosphere in which the waters of its present seas were vaporized, and which contained, as carbon dioxide, the carbon now found in its beds of limestone and coal and in the vegetation covering its surface. In time the surface of this mass had colored until a thin crust had formed, and the vapor began to condense, at first into a boiling sea, covering the entire surface, and overhung by a pall of cloud so dense as to shut out the light. It was then that "the earth was without form and void," for no land had appeared—"and darkness was upon the face of the deep."

With further cooling and consequent contraction of the interior mass the crust was wrinkled and folded, being lifted into land areas in some places and deepened into ocean basins in others. The seas were shallow at first, and their waves beat upon their shores and ground them to sand, as they are doing today, dissolving out of this sand the soluble portions.

It is probable that the earliest living organisms were microscopic, colorless, single celled plants, appearing in the barren, sandy beaches of the primeval seas while the sun was still obscured, obtaining their mineral food from the slowly dissolving sands, their carbon from the heavily charged atmosphere circulating in the upper layers of the sand, and their nitrogen from the same source; plants similar in character to the bacteria which live under the surface of the soil today, some of which undoubtedly still have the power of fixing free nitrogen, although now they may obtain their carbon either directly from carbon dioxide or from the accumulated organic matter of the soil, or indirectly through symbiosis, as in the case of the nodule formers of the clover roots.

With increase of light green plants made their appearance—green algae on the surface of the sands and lichens on the rocks of the rising mountains, just such lichens and algae as we find today in shaded, rocky ravines, and in sandy places where light is dim and moisture abundant, obtaining the mineral elements of their sustenance from sources inaccessible to the plants we cultivate.

Having run their allotted course of existence, each generation of these humblest of organisms left behind in the sands of the shore, or of the slowly crumbling surface of the rock, a little additional plant food, wrested from the face of the rocks and sands, and from the inert nitrogen of the air converted into a form available to plants of a higher order and stored in a substance much more easily soluble than the bare rock, and yet not so readily washed away as are the mineral salts, a substance to which we apply the term humus.

In due time the higher plants made their appearance, feeding upon the stores provided for them by the soil organisms, and returning these stores to the soil again in their own decay. To some extent, no doubt, these higher plants have increased the available plant food in the soil by direct action of their root fluids upon the particles of sand and clay; but it seems probable that this action is comparatively insignificant, and that the actual accumulation of both mineral and nitrogenous plant food in the soil in available form, is still largely the work of soil organisms. This view is supported by the fact that the productiveness of a soil is, up to a certain limit, proportionate to its humus content. The washed sands of the seashore, the wind-sifted sands of the dunes, or the clays brought up from deep excavations, support but a meager growth of vegetation, until manure or fertilizers carrying soluble plant food, both nitrogenous and mineral, are added.

If the function of humus were only that of a nitrogen purveyor, we should be able to restore the fertility of a soil depleted of humus by the addition of fertilizers carrying nitrogen only; but experience has taught us that such soils demand some of the mineral elements of fertility quite as urgently as nitrogen.

For example: Twelve years ago at the Ohio Experiment Station a soil, depleted of its humus by many years of tenant husbandry, was put under a 5-year rotation of corn, oats and wheat, one year each, followed by two years in clover and timothy. One plot in this experiment has been fertilized with nitrate of soda, 160 pounds per acre annually on each of the cereal crops, or 480 pounds for each 5-year rotation. This application has increased the 12-year average yield, over that of unfertilized land alongside, by 4.33 bushels each of corn and oats, 1.89 bushels of wheat and 646 pounds of hay.

On another plot the cereal crops have received for each rotation 320 pounds of acid phosphate and 260 pounds of muriate of potash, with the result that the yield of corn has been increased by 12.22 bushels, that of oats by 11.43 bushels, that of wheat by 8.68 bushels and that of hay by 997 pounds. In other words, the average increase from the mineral fertilizers has been about three times as great as that from the fertilizer carrying nitrogen only.

On a third plot the same quantities of nitrate of soda, acid phosphate and muriate of potash have been combined, with the result that the yield of corn has been increased by an average of 16.18 bushels, that of oats by 18.72 bushels, and that of wheat by 15.50 bushels. This increased yield of corn is practically equal to the sum of the increases from the separate applications of the nitrogenous and mineral fertilizers, but those of the other crops are very much greater than this sum.

If we estimate the value of corn at 50 cents a bushel for the grain and $3.00 per ton for the stover; that of oats at 30 cents a bushel and $2.00 per ton for the straw; that of wheat at 80 cents a bushel and $2.00 per ton, and that of hay at $8.00 per ton, the combined increase from the different crops of the rotation would have a total value of $7.80 for the nitrogen alone, $21.23 for the phosphorus and potassium, and $35.88 for the complete fertilizers, thus bringing out very forcibly the need of phosphorus and potassium, as well as of nitrogen, to restore the fertility of this exhausted soil.

The humus of the soil is, therefore, the great storage battery of its elements of fertility, mineral as well as nitrogenous. It is in this store, chiefly or altogether, that our crops find their sustenance. When this store is exhausted they starve, and in proportion as it is reduced do they suffer from hunger. This humus is the result largely, if not chiefly, of the growth of miscroscopic organisms, working through eons of time. Under natural conditions it slowly accumulates, but when these conditions are disturbed it may be wasted so rapidly that a few years may suffice to exhaust stores of fertility that have been ages upon ages accumulating.

This does not mean that the character of the original rocks, from which a soil's mineral constituents have been derived, is a matter of no consequence. The superiority of soils to whose formation limestones have contributed is a matter of universal experience, and if these limestones have contained phosphatic deposits, as in the case of the famous blue-grass region of Kentucky, their owners are fortunate indeed. But it seems probable that the excess of lime in such soils is not required so much for the direct nutrition of the higher plants as for the support of the processes by which the nitrogen of the soil is made available.

For instance clover, which stores several times as much lime in its tissues as either of the cereal crops, and which is also dependent upon the help of soil bacteria for the securing of its nitrogen supply, has nearly ceased to grow upon the land used in the experiments just alluded to, and no fertilizer or manure produces a normal growth of clover until lime is added.

In these experiments the fertilizing materials are distributed over the three cereal crops, the mixed clover and timothy following without any further fertilizing. Since 1900 lime has been applied to the surface of one-half of each plot, both fertilized and unfertilized, after the land has been prepared for corn; the lime is plowed under in preparing the land for oats, and plowed up again for wheat, thus securing a thorough distribution. The effect upon clover is given below, in the average weight of the first year's hay, chiefly clover, for the three seasons, 1903, 1904 and 1905:

Treatment.	Yield per acre pounds.
No fertilizer, no lime	1,650
No fertilizer, lime	2,800
Phosphorus and potassium, no lime	2,133
Phosphorus, potassium and lime	3,816
Phosphorus, potassium and nitrogen, no lime	3,369
Phosphorus potassium, nitrogen and lime	4,211
Barnyard manure, no lime	3,035
Barnyard manure and lime	4,028

These results demonstrate the necessity of an abundant supply of lime in the soil for the production of clover, but the more fully we understand the nature of the forces which make for the maintenance of soil fertility, the greater becomes the relative importance of clover as a part of a systematic crop rotation; hence a soil which is naturally well stored with lime must have a much greater agricultural value than one in which the lime supply is deficient.

Under natural conditions, the herbage which grows upon the soil decays upon it again, thus returning not only the original mineral elements which it has drawn from the soil, but a little more nitrogen than the soil had furnished; but when the farmer begins his operations he not only stimulates a greater draft upon the soil by cultural methods which cause a larger growth than would otherwise have taken place, but, instead of permitting this growth to return to the land, he removes the major portion of it, leaving only the roots and a little stubble. Further than this the cultivation, which enables his crop to secure a larger supply of plant food from the soil, also sets up conditions which involve a considerable waste of that supply, unless these conditions are understood and the waste prevented by intelligent management. For example, in the Rothamsted experiments, more than 50 years ago, an acre of land was set aside for a study of the effect of fallowing; half this acre being sown in wheat each year and the other half being fallowed, the two halves alternating each year. The result has been that the average produce from this acre for 40 years was 8 5-8 bushels, while that from land adjoining, growing wheat every year, was 12 3-4 bushels per acre, thus showing that a bare fallow may consume half as much fertility as a crop of grain.

The explanation of this outcome probably lies in the fact that the processes which we call decay, and through which the roots and other remains of vegetation left in the soil are decomposed and made available for future plant growth, are also vegetative processes, due to the work of micro-organisms, similar in function to those which have already been mentioned.

These are the so-called nitrifying bacteria. They are constantly at work in the soil when the temperature is above the freezing point, and their work is greatly facilitated by tillage and cultivation. Their function is to tear down and decompose the vegetable debris in the soil, to convert its inert nitrogen into nitric acid, and at the same time to liberate its mineral constituents. If there be a growing crop on the land its roots will absorb the plant food thus set free; but if there be no such crop this available plant food, both nitrogenous and mineral, will be largely carried into the drainage waters, in humid climates and lost, or in case the rainfall does not exceed evaporation, the unused plant food will accumulate in the soil, the nitric acid combining with lime or other alkaline base to form a nitrate salt, thus explaining the great fertility of the soils of the arid regions and the increased crops which have been observed to follow seasons of drouth in humid countries.

If the soil be deficient in lime, however, or other alkaline base, the accumulation of nitric acid may possibly cause, or assist in causing, the injurious acidity which is being observed in some of our badly worn soils.

Of all the bread plants adapted to our soil and climate, none yields so large a quantity of potential food to the acre as Indian corn. A yield of 100 bushels to the acre,which is quite within easy possibility, means a total product, exclusive of roots and stubble, of 6 to 7 tons of air-dry matter all of which may be utilized as food by man or beast. A corresponding crop of wheat would be 40 bushels to the acre, weighing, with its straw, 3 1-2 to 4 tons. 100 bushels of corn with its cobs and stover, will carry from the soil about 160 pounds of nitrogen; 40 bushels of wheat, with its straw half as much. The 100-bushel corn crop will require about 2 1-2 times as much phosphorus and three times as much potassium as the 40 bushel wheat crop.

The corn crop grows during the hot summer months, when the nitrifying bacteria are most actively at work; wheat makes its growth largely during the cooler weather of the fall and spring. Not only this, but to stimulate the work of nitrification in our corn fields by stirring the soil at intervals during the season, distributing the organisms throughout the soil and keeping them well supplied with oxygen, without which that work would cease.

At the Ohio Experiment Station an acre each of corn, oats and wheat has been grown continuously on the same land for 12 years. These acres lie side by side, on land uniform in character, and of low fertility at the beginning of the test. Considering the grain alone, and comparing the yields by 6-year periods, the average unfertilized yield of corn has fallen from 26 bushels per acre for the first periol, to 14 2-5 bushels for the second, a loss of 45 per cent; that of oats, from 28 bushels for the first period to 23 1-3 bushels for the second, a loss of 17 per cent, and that of wheat from 9 bushels for the first period to 7 3-5 bushels for the second, a loss of 15 per cent. The rate of decrease in yield, therefore, has been three times as great for corn as for wheat, and nearly three times as great for corn as for oats.

Professor Harry Snyder of the Minnesota Experiment Station has shown that the waste of soil nitrogen may be indefinitely greater than the quantity utilized. For twelve years in succesion he grew wheat on the same land. He determined the nitrogen in the soil at the beginning and end of this period, and found that there had been a reduction of more than 2,000 pounds per acre, or 26 per cent of the quantity found in the soil at the beginning of the test. Of this loss, only 450 pounds could be acounted for in the crops taken off the land, showing that nearly 1,600 pounds had been lost mainly through decay of the humus and liberation of the nitrogen.

II.

When our fathers took possession of the second Garden of Eden, the great Valley of the Mississippi, they found a soil practically untouched by man since the world began and stored with potential bread for millions upon millions of people. Forthwith they began to plow and sow and reap, and the world was fed. And when they were warned that their soil was not an inexhaustible bank, which could be drawn upon forever without restitution, they hooted at the counsel given and went ahead as before stimulating the soil to its utmost production by the thorough tillage which modern implements made possible, implements driven with an untiring industry, and then removing from it the entire crop produced, and if any restitution was made in manure it was so inadequate in quantity and so deteriorated in quality by unwise management as to be but an insignificant factor in staying the course of fertility depletion.

In table I is shown the course of corn and wheat production in four states lying in the heart of the corn belt—Ohio, Indiana, Illinois and

I.—FORTY YEARS OF CORN AND WHEAT.

Period.	Average yield in bushels per acre.				Acres grown in census year.
	Corn.				
	Ohio.	Indiana.	Illinois.	Missouri.	
1865-1874	36.0	33.0	30.0	30.4	13,860,000
1875-1884	32.3	29.8	27.5	29.1	21,538,000
1885-1894	29.2	29.2	28.3	27.2	20,711,000
1895-1904	34.2	33.2	34.2	27.7	25,165,000
	Wheat.				
1865-1874	12.0	10.9	11.9	13.1	5,993,000
1875-1884	14.5	13.8	13.3	11.6	9,985,000
1885-1894	13.9	13.9	14.1	12.9	9,027,000
1895-1904	13.4	11.3	12.5	12.7	10,469,000

OHIO—STATE VS. NATIONAL STATISTICS.

Period.	Corn.		Wheat.		4 states, acres corn, wheat and oats.
	State.	National.	State.	National.	
1865-1874	35.4	36.0	11.4	12.0	22,800,000
1875-1884	33.7	32.3	14.1	14.5	36,500,000
1885-1894	32.8	29.2	14.5	13.9	37,600,000
1895-1904	36.0	34.2	12.9	13.4	43,600,000

Missouri—for the 40 years, 1865 to 1904, inclusive, as indicated by the statistics collected by the United States Department of Agriculture. The table shows the average yield per acre by 10-year periods, as found by taking the mean of the yearly averages, and it also shows the total area in each crop for the four states for the same periods, and the combined area in the three cereal crops, corn, wheat and oats, this combination being added because there has been in Illinois a considerable shifting during later years from wheat to oats. The figures for area are for the census years only, and are compiled from the reports of the eleventh census, except for the first period, which is compiled from the estimates of the Department of Agriculture. These estimates in turn are based upon those of crop correspondents scattered throughout the country. To test their accuracy, a table has been compiled, in which they are compared with statistics collected annually by the township assessors of Ohio. It will be seen that, while the two sets of statistics differ slightly in minor details, they point to the same general conclusion, namely: that the close of this forty-year period finds this group of states producing practically the same quantity of grain per acre as the beginning.

In corn, the averages for the entire state of Ohio, as made up from the assessors' statistics, indicate that, after a steady reduction in yield for 30 years, that reduction has been overcome at the end of the period. A study of these statistics by counties, however, shows that this apparent increase during the later period, is chiefly found in the northwestern counties, where large areas of fertile land have, within a comparatively recent period, been reclaimed from a semi-swawp condition by drainage. In the river valleys, which have been the great cornfields of the State from its earliest settlement, there has been a very general decrease in yield during the last 25 years. The National statistics show a stationary yield for Indiana, a small increase in yield for Illinois, and a small decrease in Missouri.

In wheat, the State statistics show a small increase in yield for Ohio, but an analysis of these statistics shows that this increase is found practically altogether in the northen half of the State, where it has been brought about by a large and increasing use of commercial fertilizers in the northeastern counties, and by extensive drainage in the northwestern region. Both State and National statistics show a decreased yield of wheat in Ohio for the last 10 years, as compared with the two decades immediately preceding, and the National statistics indicate a similar condition for Indiana and Illinois.

When we remember that these averages include the crops of many good farmers whose yields never fall to the level of such averages; that they cover a period during which the area of new land brought under the plow has nearly equalled that in cultivation at its beginning; that an immense amount of drainage has been done, adding enormously to the potential productiveness of the soil; that tillage implements have been brought to a state of perfection for beyond that known before, thus further increasing the farmer's control of the soil; that some thought at least has been given to crop rotation and the use of manures and fertilizers—enough in Ohio to lead to an annual expenditure for commercial fertilizers of more than a million and half of dollars during the last decade of this period; when all these factors, which should make for increase of crop production, are set over against the figures above given, we are compelled to admit that if this is the best that can be done the future outlook for food for the world's rapidly increasing population is indeed a gloomy one.

But this is not the best that can be done. Scattered throughout this region are many farms that are today producing larger crops than when first reclaimed from forest or prairie, and whose rate of production is steadily increasing; and when we study the method by which the fertility of these farms has been maintained we find that it has been based upon conservation and increase of the humus supply, a method as old as agriculture, and yet its importance is so seldom realized, and the means of employing it so imperfectly understood, that the prevailing tendency of our agriculture is towards the steady depletion of this supply.

About the middle of the 40-year period under review the use of chemical or commercial fertilizers became common in Ohio. The development of the great range industry of the west had caused a heavy decrease in the price of meat producing animals, while the extension of railroads had made it easier to dispose of grain, so that our farmers reduced their live stock, sold their grain instead of feeding it, and attempted to maintain the fertility of their fields by the purchase of commercial fertilizers. The outcome of this policy has been that the century closed with no more live stock on Ohio farms, based upon potential manure production, than was found there 50 years before, while the area cultivated in cereal crops was three times as great.

It was soon discovered that, in large sections of the State, fertilizers containing phosphorus would produce a marked increase in the yield of wheat, and especially marked improvement in the appearance of the plant; phosphated wheat starting earlier in the fall, growing more rapidly and maturing earlier than that not so treated.

The addition of nitrogen and potassium to the fertilizer very materially increased its cost, and, so far as could be judged by observation of the growing crop, failed to produce an increase of yield commensurate with the increase of cost. Farmers seldom carry their tests to the point of actual weights and measurements, and consequently the opinion became general that the nitrogen supply, at least, would take care of itself. With some farmers, who continued to use considerable quantities of manure, re-enforcing this with small additions of commercial fertilizers, this opinion was well founded; but many accepted the conclusions of these farmers as adapted to farms where no such supply of nitrogen was maintained. The consequence has been that the land has become more and more depleted of its humus, the phosphates used accelerating this depletion; the yield of corn is diminishing, and that of wheat is maintained only by constantly increasing purchases of fertilizers.

III.

One of the farms purchased by the Ohio Experiment Station on its removal to Wayne county had been rented for many years before it came into possession of the station and was reduced to a very low state of productiveness. On this farm a 5-year rotation of corn, oats, wheat clover and timothy has been maintained since 1894, the rotation being so planned that each crop is represented every season.

In this experiment the land is divided into long, narrow plots, containing one-tenth acre each. Every third plot is left continuously unfertilized, while the intervening plots receive different fertilizing compounds, the fertilizing of each plot having been continued under a definite plan since the beginning of the test. The experiment has now been in progress for 12 years. It was so planned that during the first 5 years of this period, 1894 to 1898 inclusive, 5 crops of each of the cereals were grown, with 4 crops of clover and 3 of timothy, the fertilizers being applied to the cereal crops only. The average yields on the unfertilized land for this period and for the subsequent 7-year period are given in Table II.

II.—AVERAGE UNFERTILIZED YIELD.

	5 years—1894-1898.	7 years—1899-1905.
Corn	31.9 bus. grain, 1,613 lbs. stover.	29.1 bus. grain, 1,554 lbs. stover.
Oats	30.9 " " 1,214 " straw.	32.5 " " 1,204 " straw.
Wheat	9.3 " " 979 " "	8.2 " " 843 " "
Clover	1,829 lbs. hay.	1,849 lbs. hay.
Timothy	2,334 " "	2,156 " "

The average annual unfertilized yield of corn has fallen off 3.8 bushels per acre for the second period as compared with the first; that of oats is 1.6 bushel greater during the second period; that of wheat is 1.1 bushel smaller; that of clover is 20 pounds greater and that of timothy is 178 pounds smaller.

The unfertilized yields above given are the average for the entire series of unfertilized plots. In comparing the effect of the different fertilizers, however, the yield of each fertilized plot is compared with that of the two unfertilized plots between which it lies, not with the general average. On this basis the land which has received acid phosphate only is found to have produced the yields, in excess of those given by the unfertilized land alongside, shown in table III.

III.—AVERAGE INCREASE PER ACRE FROM ACID PHOSPHATE.

	5 years—1894-1898.	7 years—1899-1905.
Corn....................	3.96 bus. grain, 3 lbs. stover.	9.67 bus. grain, 304 lbs. stover.
Oats....................	5.34 " " 83 " straw.	10.44 " " 412 " straw.
Wheat....................	3.14 " " 426 " "	10.25 " " 884 " "
Clover....................	389 lbs. hay.	285 lbs. hay.
Timothy....................	186 " "	67 " "

If we value corn at 40 cents per bushel, oats at 30 cents, wheat at 80 cents, hay at 8 dollars per ton, corn stover at 3 dollars and straw at 2 dollars, the increase produced by a total application of 320 pounds of acid phosphate, costing about $2.40, will have a total average value of $8.44 per acre for each rotation during the first 5 years, and of $18.20 per acre during the 7-year period following, leaving a net gain, after deducting the cost of the fertilizer, $6.04 per acre for the first period and $15.82 per acre for the second.

On that portion of the land fertilized with both acid phosphate and muriate of potash the increase has been as shown in table IV.

IV.—AVERAGE INCREASE PER ACRE FROM ACID PHOSPHATE AND MURIATE OF POTASH.

	5 years—1894-1898.	7 years—1899-1905.
Corn....................	7.21 bus. grain, 285 lbs. stover.	15.80 bus. grain, 692 lbs. stover.
Oats....................	6.87 " " 277 " straw.	14.70 " " 623 " straw.
Wheat....................	5.22 " " 465 " "	11.16 " " 896 " "
Clover....................	806 lbs. hay.	526 lbs. hay.
Timothy....................	1,130 " "	441 " "

Using the same valuation as before, the increase from the combination of acid phosphate with muriate of potash has had a total value for each rotation of $18.02 per acre during the first period, and of $26.08 during the second. Deducting the cost of the fertilizer we have a net gain of $9.12 per acre for the first period and of $17.18 for the second.

When nitrate of soda has been substituted for muriate of potash the increase has been as shown in table V.

V.—AVERAGE INCREASE PER ACRE FROM ACID PHOSPHATE AND NITRATE OF SODA.

	5 years—1894-1898.	7 years—1899-1905.
Corn	9.65 bus. grain, 217 lbs. stover.	16.73 bus. grain, 500 lbs. stover.
Oats	8.26 " " 299 " straw.	19.62 " " 789 " straw.
Wheat	6.81 " " 893 " "	16.07 " " 1,502 " "
Clover	1,066 lbs. hay.	916 lbs. hay.
Timothy	607 " "	786 " "

The increase from this combination thus shows a total value for each rotation of $19.98 for the first period and of $35.24 for the second, leaving a net value of $5.58 for the first period and of $20.84 for the second.

On the land receiving the complete fertilizer, made up of acid phosphate, muriate of potash and nitrate of soda, the increase has been as shown in table VI.

VI.—AVERAGE INCREASE PER ACRE FROM COMPLETE FERTILIZER.

	5 years—1894-1898.	7 years—1899-1905.
Corn	10.72 bus. grain, 323 lbs. stover.	20.08 bus. grain, 750 lbs. stover.
Oats	12.92 " " 609 " straw.	23.86 " " 1,015 " straw.
Wheat	10.73 " " 1,331 " "	18.91 " " 1,931 " "
Clover	1,033 lbs. hay.	1,121 lbs. hay.
Timothy	613 " "	960 " "

The total value of the increase in this case amounts to $25.72 for the first period and $42.47 for the second, leaving a net value of $4.82 for the first period and $21.57 for the second.

It will be observed that in every case the fertilizers have produced a very much greater increase in the cereal crops during the second period than during the first, while the hay crops have shown a marked falling off in the rate of increase during the second period, except where nitrate of soda entered into the composition of the fertilizer. In 1900 and since, lime has been applied to one half the land in this experiment as it was being prepared for corn, with the result that the limed land has shown a somewhat greater yield of corn, oats and wheat, followed by a very much larger yield of clover and timothy than the unlimed land. It now appears probable that if all the land had been limed once in each rotation, at the rate of a ton of lime to the acre, not only the unfertilized yields but also the total and net increase from the fertilizers on all the crops would have been considerably greater than it has been.

Taking the experiment as it stands, we see that acid phosphate has been decidedly the most effective of the three fertilizing materials used in producing increase of crop in the cereals. Ordinarly we assume that the only element of value in acid phosphate is phosphorus, but the question may be raised whether, in this soil, hungry for lime as it has been shown to be, the lime carried in the acid phosphate may not have contributed to the increase of crop. It is true that since the use of lime was begun the limed ends of the unfertilized plots have given an average yield of corn, 10 bushels to the acre greater than that given by the unlimed ends, but this yield has been further increased by 11 bushels per the acre on the limed ends, against 12 bushels on the unlimed ends, on the plots receiving acid phosphate only, thus indicating that the lime in the acid phosphate has played but a very small part in the increase produced by this material.

Muriate of potash and nitrate of soda, whether used separately or in combination, have produced a comparatively small effect and have been used at a pecuniary loss unless combined with the phosphate, yet the addition of these substances to the phosphate produces not only a greater total yield but also a greater net gain than that derived from any partial fertilizer, notwithstanding the fact that the cost of the complete fertilizer is eight times as great as that of the acid phosphate alone.

The actual total yields, for the two periods, of the land receiving this complete fertilizer are given in table VII.

VII.—AVERAGE TOTAL YIELDS PER ACRE FROM COMPLETE FERTILIZERS.

	5 years—1894-1898.		7 years—1899-1905.	
Corn	41.3 bus. grain,	1,821 lbs. stover.	48.3 bus. grain,	2,160 lbs. stover.
Oats	43.6 " "	1,809 lbs. straw.	55.7 " "	2,203 " straw.
Wheat	20.5 " "	2,356 " "	27.0 " "	2,788 " "
Clover	2,740 lbs. hay.		3,107 lbs. hay.	
Timothy	2,943 " "		3,421 " "	

In other words, the presistent use of a complete chemical fertilizer of very high grade, on crops grown in systematic rotation, has brought up this run down farm to such a state of productiveness that it is now producing, as a 7-year average, more than 47 bushels of corn and 55 bushels of oats to the acre, 27 bushels of wheat, and more than a ton and a half of hay, and while bringing the land up to this point the fertilizer not only paid for itself, but has paid a high annual rental on the land besides.

The question will naturally arise, whether the fertilizing materials have been used in this test in the most economical proportions to each other, and especially whether a larger proportion of phosphorus to nitrogen might not have been employed to advantage. This question is partially answered by one of the plots in this experiment on which, for the last 7 years, the total dressing of acid phosphate has been increased to 480 pounds, and that of nitrate of soda has been reduced to 240 pounds for the rotation, the quantity of muriate of potash remaining unchanged; this change reducing the cost of the fertilizer to $16.10 for the entire rotation.

The result is given in table VIII.

VIII.—AVERAGE TOTAL YIELD AND INCREASE PER ACRE FROM COMPLETE FERTILIZER WITH MORE PHOSPHORUS AND LESS NITROGEN.

	7 years—1899-1905.			
	Total yield per acre.		Increase per acre.	
Corn	49.5 bus. grain,	2,361 lbs. stover.	20.89 bus. grain,	805 lbs. stover.
Oats..	54.3 " "	2,293 " straw.	23.53 " "	1,140 " straw.
Wheat	23.0 " "	2,200 " "	15.48 " "	1,433 " "
Clover.......	2,562 lbs. hay.		766 lb. hay.	
Timothy	2,833 " "		685 " "	

It will be observed that the total yields from this combination are smaller in everp crop except the corn than from the one carrying more nitrogen and less phosphorous. The increase appears slightly larger in the corn and oats crops, but the wheat and hay crops show the opposite effect, and the net value of the increase, which amounts to $21.32, is slightly smaller than from the more expensive fertilizer.

On the other hand, is it possible to still further increase the nitrogen in the fertilizer to advantage? This question has been put to test on a plot which has received for each rotation 720 pounds of nitrate of soda—240 pounds on each of the cereal crops—combined with the standard application of 320 pounds acid phosphate and 260 pounds muriate of potash, the cost of the total application being raised to $26.90 for each rotation. The results are shown in table IX.

IX.—AVERAGE TOTAL YIELD AND INCREASE PER ACRE FROM COMPLETE FERTILIZER WITH LARGER AMOUNT OF NITRATE OF SODA.

	7 years—1899-1905.	
	Total yield per acre.	Increase per acre.
Corn	49.9 bus. grain, 2,332 lbs. stover.	21.30 bus. grain, 822 lbs. stover.
Oats	55.2 " " 2,375 " straw.	22.24 " " 1,153 " straw.
Wheat	28.7 " " 2,796 " "	20.55 " " 1,941 " "
Clover	3,097 lbs. hay.	1,152 lbs. hay.
Timothy	3,402 " "	939 " "

The aggregate value of the increase from this fertilizer amounts to $44.28, or a little more than from the smaller applications, but the additional cost of the fertilizer is so much greater that the net gain is reduced to $17.38. It appears, therefore, that the dressing of 160 pounds of nitrate of soda per acre, or one pound per square rod, repeated three times in the course of a 5-year rotation, has not been excessive, but has, in fact, given a larger net gain than either a smaller or a larger quantity.

For more convenient comparison the results for the last 7 years are summarized in table X.

X.—SUMMARY OF TABLES II TO IX.

Fertilizers per acre.			Value of increase.	
Kind.	Quantity.	Cost.	Total.	Net.
	Lbs.			
Acid phosphate	320	$2 40	$18 20	$15 80
Acid phosphate Muriate of potash	320 260	8 90	26 08	17 18
Acid phosphate Nitrate of soda	320 480	14 40	35 24	20 84
Acid phosphate Muriate of potash Nitrate of soda	320 260 480	20 90	42 47	21 57
Acid phosphate Muriate of potash Nitrate of soda	480 260 240	16 10	37 42	21 32
Acid phosphate Muriate of potash Nitrate of soda	320 260 720	26 90	44 32	17 42

Next to nitrogen, potassium has been the most expensive element of the fertilizer. If we compare the increase from acid phosphate alone with that from acid phosphate and muriate of potash; or that from acid phosphate and nitrate of soda, with that from the complete fertilizer, we find that in both cases the cost of he muriate of potash has been more than recovered in the additional increase from the fertilizer, but the margin of profit has been small. We have as yet no data from which to determine definitely whether a smaller application of potassium would have been more economical, but the results of the experiment would encourage the endeavor to find a cheaper source of potassium, rather than to reduce the quantity used, and this is equally true of nitrogen. Taking the combination of fertilizers which has produced the greatest net gain, we note that it consists of 320 pounds of acid phosphate, costing $2.40, 260 pounds of muriate of potash, costing $6.50, and 4.80 pounds of nitrate of soda, costing $12.00, or $18.50 for potassium and nitrogen, against $2.40 for phosphorus. The total value of the increase from this combination has been 42.47, leaving a net value of $21.57 after paying for the expensive fertilizer used; but if only the phosphorous had been bought, the nitrogen and potassium being secured on the farm without cost—as they may be—the net profit would have been $40 per acre for the 5-year period, instead of $21.

IV.

THE FARM SUPPLY OF NITROGEN AND POTASSIUM.

Since 1897 there has been in progress on the same farm on which the experiments above described are located, a 3-year rotation of corn, wheat and clover, each crop in this case, as in the other, being grown every season after the first. The average unfertilized yields in this test have been as wollows:

XI.—AVERAGE UNFERTILIZED YIELDS IN 3-YEAR ROTATION OF CORN, WHEAT AND CLOVER FOR THE 9 YEARS, 1897-1905.

Corn (9 years)..	37.4 bus. grain, 2,198 lbs. stover.
Wheat (8 years)..	8.9 " " 1,022 " "
Clover*..	1,963 lbs. hay.

*For the 5 years, 1901-1995, Soy beans were grown instead of clover during the first 3 years and these were plowed under.

It will be observed that the unfertilized yield of corn in this experiment has been several bushels larger than in the rotation first described, the corn in the shorter rotation being grown on clover sod, in the longer one on timothy sod. The wheat yields are practically the same in the two tests, if we compare on the basis of the entire 12-year period of the longer rotation. The clover yields are a little larger in the shorter rotation.

Two series of plots in this experiment have been manured for each corn crop with cattle manure, that used on the one series being manure which had lain in an open barnyard for several months during the winter, while that for the other series has been taken directly to the field from box stalls, where it has been trampled under foot while accumulating. If there has been any difference in the feed from which the manure was made it has been in favor of the open yard manure. The manure has been used in all cases at the rate of 8 tons per acre. It is spread on the clover sod in the spring and plowed under. The wheat and clover follow without any further manuring or fertilizing.

Manure not only wastes by leaching when exposed to the weather, but it is also subjected to heavy losses of ammonia when so managed that heating and consequent chemical action take place. Moreover, the fact that phosphatic fertilizers produce such a remarkable effect on many soils which have been long in cultivation, indicates that ordinary farm manure is either deficient in phosphorus, or that its phosphorus becomes relatively less available to crops than its nitrogen and potassium. In the hope of obtaining suggestions as to the practicability of diminishing the loss of ammonia on the one hand, and of rendering the nitrogen and potassium of the manure more effective by increasing the supply of phosphorus on the other, the following treatment has been given to lots of each kind of manure—yard and stall—since the beginning of this experiment.

One lot of each kind has been dusted with gypsum, or land plaster, and another lot with kainit, a crude potash salt, these substances having been shown to be useful in arresting escaping ammonia; a third lot has been treated with floats, the finely ground, phosphatic rock from which acid phosphate is made by the addition of sulphuric acid, and a fourth lot with acid phosphate itself, these materials being used on the assumption that they would probably be as efficient as gypsum or kainit in arresting ammonia, and would have the further advantage of re-enforcing the manure with phosphorus. In the use of the floats a further object was to learn whether this material, which is almost completely insoluble in its ordinary condition, might not be rendered soluble by the fermentation of the manure, and thus obviate the necessity of treating it with acid.

These various materials have been applied to the manure in the spring, usually in March or early in April, at the uniform rate of 40 pounds per ton of manure; manure being taken from the open barnyard where it had lain during the winter, for the "yard manure" series, and from box stalls, where it had been accumulating for several months, for the "stall manure" series.

After dusting the manure with the various materials it has been allowed to lie in heaps for a few weeks, when it has been spread on the clover sod and plowed under for corn. This method of leaving the treatment until spring has been followed in order to make sure of using the same quantity of each material on uniform lots of manure. It is believed that the better way, as a farm practice, is to use the conserving materials daily in the stables, while the manure is accumulating, in order to have them in contact with the manure as long as possible before it is drawn to the field. This is believed to apply especially to floats, as it would seem most desirable that this material should be subjected for a considerable time to the direct action of the manure. The results of this test for the last six years, omitting the first rotation, as in the other test, are given in table XII.

XII.—TREATMENT OF FARM MANURE: SIX-YEAR AVERAGE INCREASE PER ACRE, COST OF TREATMENT AND VALUE OF INCREASE.

Manure and treatment.	Cost of treatment.	Increase per acre.					Value of increase.		
		Corn.		Wheat.		Hay lbs.	Total per acre.	Net per acre.	Per ton of manure.
		Ear-corn bus.	Stover lbs.	Grain bus.	Straw lbs.				
Yard manure untreated.....	....	15.45	837	8.87	924	686	$18 20	$18 20	$2 27
With gypsum..................	$1 28	20.99	1,166	13.40	1,314	1,022	26 27	24 99	3 12
With kainit.........	2 72	21.37	1,328	12.21	1,174	1,293	26 65	23 93	2 99
With floats........ ..:.	1 28	22.22	1,279	14.51	1,384	1,727	28 71	27 43	3 43
With acid phosphate.........	2 40	28.60	1,388	15.70	1,506	1,826	34 89	32 49	4 06
Stall manure untreated.. ..	....	21.66	1,281	11.32	1,126	1,309	26 00	26 00	3 25
With gypsum..................	1 28	24.20	1,530	14.18	1,502	1,331	30 15	28 87	3 61
With kainit............	2 72	26.31	1,736	14.93	1,611	1,948	34 47	31 75	3 97
With floats...	1 28	28.95	1,768	17.23	1,697	2,504	38 73	37 45	4 68
With acid phosphate.........	2 40	31.94	1,765	17.68	1,774	2,648	41 93	39 53	4 94

This table shows that 320 pounds of acid phosphate and 8 tons of stall manure, used in combination, have produced every 3 years, as the average of six 3-year rotations, a total increase to the value of $41.93, or within a few cents of the same amount as that produced in 5 years by the same quantity of acid phosphate in combination with 260 pounds of muriate of potash and 480 pounds of nitrate of soda. Our analyses indicate that the 8 tons of manure have carried about the same quantity of nitrogen as that found in 480 pounds of nitrate of soda, but considerably less potassium than would be carried in 260 pounds of muriate of potash. It appears, therefore, that these constituents of fertility are at least as effective in fresh stable manure, from well fed cattle, as in the two chemicals used in these experiments, and which are among the most effective, and at the same time the cheapest of commercial carriers of nitrogen and potash, respectively, provided the manure be re-enforced with a supply of readily available phosphorus.

The cost of nitrate of soda and muriate of potash at retail, freight paid to Ohio, is about 2 1-2 cents per pound, so that the 8 tons of manure has replaced chemicals costing $18.50.

It is true that it costs more to apply stable manure than commercial fertilizers, but after making full allowance on this point we still have a value of at least $2.00 per ton for the manure, as compared with commercial fertilizers of equal efficiency in crop production.

V.

THE PRODUCTION OF MANURE.

In feeding experiments at the Ohio station, a careful record has been kept of feed and bedding consumed, of increase in live weight and of manure produced. These experiments have shown that, under average conditions, the increase in live weight should pay for the feed consumed and labor of feeding, leaving the manure as clear gain. The production of manure has been 35 to 42 pounds per day for a 1000-pound steer, exclusive of bedding, and the bedding has averaged 7 to 7 1-2 pounds per day. Under average conditions it is safe to estimate the manure production of a 1000-pound steer at not less than 40 pounds per day, inclusive of bedding, or 3 1-2 tons for a feeding period of 6 months. The manure from two steers, therefore, would give an application of 7 tons to an acre of land.

In the experiments last described, manure has been used at the rate of 8 tons per acre, and it is applied once in 3 years. Untreated yard manure has also been used on two plots in the 5-year rotation first described, being applied to the corn and wheat crops, at the rate of 8 tons and 4 tons per acre. Taking the results from the last 7 years and using the same valuations that have been used in other cases, the larger application has produced a total increase to the value of $34.42 for each rotation, or $2.15 per ton of manure—a value slightly below that found from the same kind of manure in the 3-year rotation—while the smaller application has given a total increase worth $22.19, or $2.77 per ton of manure. In other words, the increase *per acre* is larger from the larger application of manure, but the increase *per ton of manure* is larger from the smaller one; hence, when the manure supply is scanty it is advisable to spread it more thinly than when it is abundant, but table XII shows that one ton of manure treated with phosphate rock and taken directly from the stable to the field may produce a greater increase than two tons of the yard manure used in the experiment just described.

In conclusion: My study of the soil has led me to the belief that the plants we cultivate have but little greater ability to obtain mineral substances required for their growth directly from the sand and clay of the soil than they have to obtain their nitrogen directly from the free nitrogen of the atmosphere, but that, in the one case as in the other, their supplies are chiefly drawn from stores accumulated and made available through the agency of microscopic organisms existing in the soil, and whose work has been going on for countless ages.

Our statistics of crop production show that the average agricultural practice of our time is tending toward the steady exhaustion of this accumulated store of fertility, while experimental data show that it is possible to secure a very much larger average yield than that ordinarily secured, and that this may be accomplished at a lower relative cost than is now required to produce the average crop.

These data also show that, while it is possible to bring up the rate of production of a run-down soil to a point exceeding that of its virgin condition by the intelligent use of chemical fertilizers, and to do this at a cost which will leave a margin of profit, yet the same result may be attained more certainly and at a very much smaller cost by the production and well informed use of animal manures, re-enforced with such fertilizing materials as may be required to more perfectly adapt these manures to the soils on which they are employed.

DISCUSSION.

Gov. Colman: Do you believe that lime is an antidote for what is termed throughout Ohio "clover sickness?"

Mr. Thorne: Yes, it is.

Mr. Wilhite: We have some land in this country where clover will not grow.

Mr. Thorne: What kind of land is it?

Dr. Waters: It is free stone land—the thinner lime-stone land that has been cultivated for a long time.

Mr. Thorne: That land has been stirred up and the surface turned over and over again and the lime has been pumped out by hard rotations of corn, oats, wheat and timothy, and the lime is being exhausted, and it will eventually all be exhausted even from limestone soils.

Gov. Colman: Have you tried phosphorus on clover land?

Mr. Thorne: Yes, but we are not getting a good stand of clover. There is not enough lime in an ordinary fertilizer to take the place of the lime that has been exhausted from the soil. It is more economical to buy the lime than to buy it in the fertilizer. The phosphorus rock costs $8 a ton and lime only about $5, and where lime accomplishes the same purpose it is best to use it.

Dr. Waters: Before you leave the lime question, let me say in our soil survey we have found one soil in Southern Missouri, known commonly as post oak flats, which shows a very little of lime in the first ten inches of soil; and the subsoil shows only a trifle of lime. That soil will have to be drilled for lime before it can be made to grow these legumes, won't it?

Mr. Thorne: Yes; clover is the chief crop to show the deficiency of lime. For a crop of clover it takes 50 pounds of lime; for wheat about 7 or 8 pounds.

Gov. Colman: Is it possible to get too much lime in the soil?

Mr. Thorne: Yes, there is great danger of that. It is possible to apply so much lime as to entirely efface the effect we wish to accomplish and make the land unfit for cropping for some time. We are using one ton of lime to the acre; we have soil which requires twice that amount—two tons to the acre. When we go beyond that amount, we begin to see the opposite effect.

Mr. ————: Do you apply lime before or after sowing the seed?

Mr. Thorne: As long before as possible. We have strong evidence that the proximity of the lime to the seed is injurious, and we want to keep them as far apart as we can.

Dr. Waters: Before we plant the seed and before we cultivate the land?

Mr. Thorne: Yes.

Mr. ————: Where you put too much lime on the ground, how long will it take it to get over that?

Mr. Thorne: I know of an instance in our state where a man put too much lime on his soil five or six years ago, and it is still in the same condition as then; has not recovered yet.

Mr. ————: How do you remedy it?

Mr. Thorne: By plowing deeper and putting on manure.

Dr. Waters: The best plan is not to do it in the first place.

Mr. Thorne: Yes. It is a waste of time and a waste of crop.

Because a little of a thing is good, it does not necessarily follow that a great deal is better.

Mr. Boles: Have you ever tried putting lime on the ground with a seed sower put on behind the wagon?

Mr. Thorne: No, we have never tried that. I doubt whether you could put on enough that way—when it comes to putting on two tons to the acre. That is the trouble with the fertilizer drill. It does not put on enough.

While on this question, I will say that there are several kinds of lime on the market. Since it has been found in our state that lime is in demand, there has been an effort made to sell an inferior lime—an air-slacked lime of no value. The lime you want is the common builders' lime.

Mr. Boles: Will it pay to use the lime that has been drawn out of the kiln for six or eight years?

Mr. Thorne: Yes, it is all right to use. But let me call your attention again to this point. Don't lime unless your land needs liming. Alfalfa is much more sensitive to a lack of lime than to it. We cannot grow alfalfa on our land until we lime the land. Where you can grow clover luxuriantly you do not need lime. Don't waste your time on lime while the clover is growing luxuriantly; but when clover begins to show this sickness, then is the time to begin to think about lime, and a pound of lime will answer the question.

THE MAINTENANCE OF SOIL FERTILITY IN GRAIN FARMING.

(Prof. J. H. Pettit, Department of Agronomy and Chemistry, College of Agriculture, Urbana, Illinois.)

We commonly consider that the yield of a crop depends upon six fundamental factors. These are the seed, the soil in the sense of a home or lodging place for the plant, plant food, heat, light and moisture. Some of these factors are at least partially under the control of the farmer. This Association of Missouri Corn Growers recognizes the great importance of good seed corn, and has done and is doing much toward its improvement and so, indirecetly, toward increasing Missouri's corn yield. The thorough farmer recognizes the importance of drainage in order to control the moisture supply of the soil and the importance of maintaining

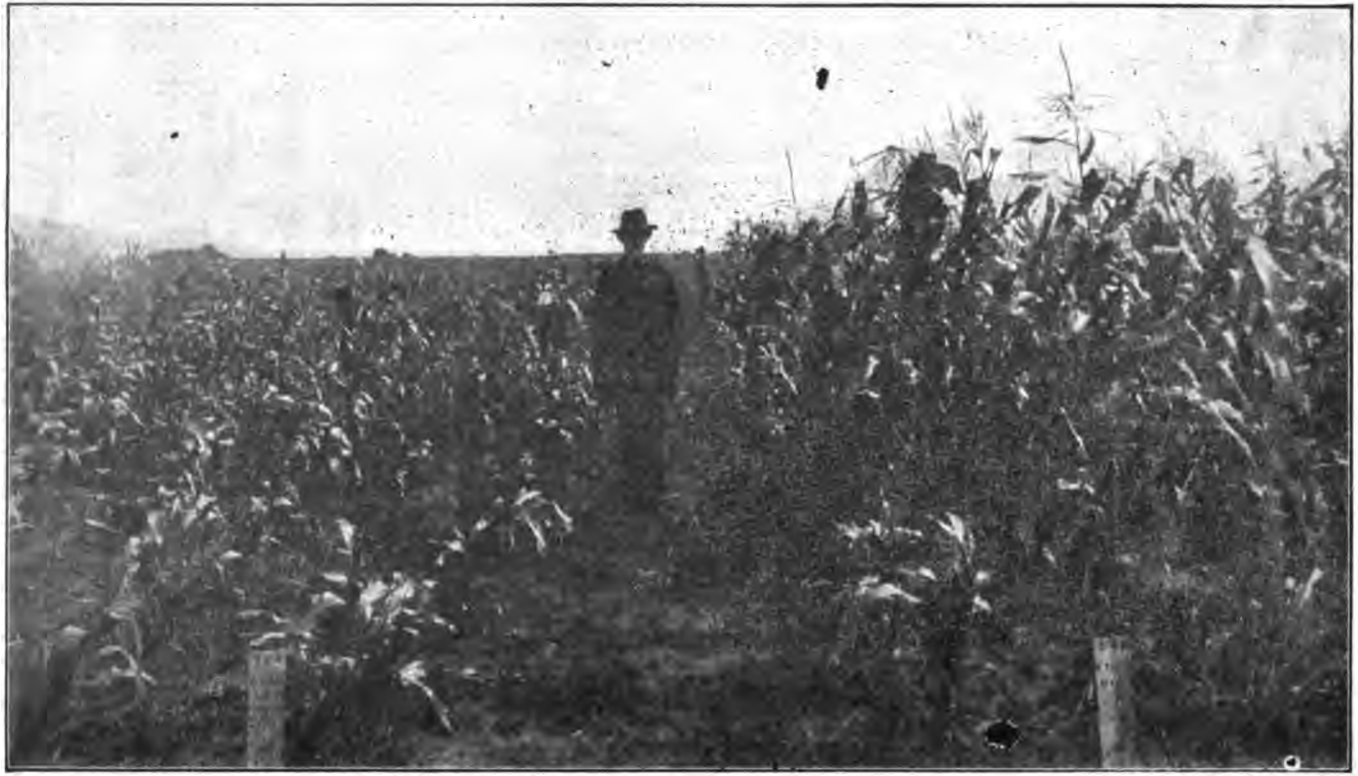


Plate 1.—Corn on Peaty Swamp Land. Nitrogen and Phosphorus on Left; Potassium on Right.

the supply of organic matter in order to keep the soil porous and in a good workable condition as well as to prevent excessive washing. We know that heat, light, and moisture, factors which we cannot control absolutely, are necessary to the germination of the seed and to the growth of the plant. We are familiar with the fact that the corn rows show up across the lower and darker places of the field earlier than they do on the higher and lighter ground. The darker area is warmer and so offers more advantageous conditions for the rapid germination of the seed. We can, by controlling the organic matter, control to some extent both heat and moisture in the soil. We are all familiar with the fact that most plants will not grow normally in the dark and that long bright days encourage rapid growth.

But the members of Missouri's Live Stock Association know that, though you may have the best pedigreed pig in the cleanest of pens with the proper supply of heat, sunlight, and water, unless you have food in the trough and food in proper proportions you will never have an animal for the show ring, to say nothing of an animal which will put dollars and cents into your pocket over the scales.

Our plants are like our animals. It is a most excellent thing that they have a long pedigree and that they be grown upon a soil which is so drained and cultivated as to make it a good home for them, and in a climate affording sufficient heat, light, and moisture, but unless they have food and food in proper proportions, they will never make the most vigorous, well developed, and profitable plants.

As individual farmers and handlers of land we want to know how to succeed in the particular kind of farming which we are doing, so that we may be assured of maintaining, and when necessary, of increasing the supply of plant food in our soils, and by this means, together with improved seed, drainage, rotation, and good cultivation, we may permanently maintain, and even increase, the productive capacity of our individual farms so that those who come after us will not be the loser because we have preceded them.

This morning we are to consider this subject from the standpoint of the grain farmer, and there is no doubt that the grain farmer has a greater problem than has the dairy or live stock farmer; for the latter feed the crops grown on their own farms, together with more or less of their neighbor's; only small quantities of plant food are sold in this way, the greater part being returned to the soil in manure which benefits the physical conditions of the soil as well. However, it must inevitably remain true that over fifty per cent of our farmers must be grain farmers in order that the human family may have its grain ration and in order that the stockman and dairyman may have the grain which they feed in addition to that which they raise.

Among the first essentials to successful grain farming so far as present knowledge goes, is the adoption of, and the close adherence to a rotation adapted to the local conditions. The injurious effects of continous grain cropping are known not only to those who have followed the development of agriculture through history but even to those who have seen the development of the corn belt in the last quarter of a century. The rotation not only effects the physical condition of the soil, but it furnishes a very practical means of combating insect ravages and fungous diseases which prey upon any particular crop, and it may also bring about favorable changes in the plant food content, in fact by the use of a legume, as clover ar cowpeas, in the rotation, the supply of one element of plant food, nitrogen, may be actually increased.

There are necessary for the development and growth of every plant ten of these elements of plant food; some of these are in the air about the plant, others are in the water, and still others are in the soil in such large proportions that they do not limit the yield. There are three of the ten, however, which, on account of their limited supply in some soils and because they are removed in comparatively large quantities by all crops, must be considered in connection with the crop producing power of soils. These three are nitrogen, phosphorus, and potassium. In the atmosphere over every acre of land there is, if valued at fifteen cents a pound, more than $10,000,000 worth of nitrogen. Most plant life, however, cannot draw upon this inexaustable supply, but must depend upon the liberation of nitrogen from the organic matter of the soil. Nature has, however, given us one class of plants called the legumes (to which class the clovers, vetches, alfalfa, peas, beans, the locust tree, and several others belong), which, through the bacteria living in the nodules upon their roots, can obtain nitrogen from the air.

Those scientists, who some years ago proved beyond a doubt that through legumes we can draw at will upon the inexhaustable supply of nitrogen in the air, settled forever the nitrogen question so far as extensive farming is concerned. Nitrogen on the market in the form of dried blood, sodium nitrate, and other commercial fertilizers, costs fifteen cents per pound, and there is one pound of it in every bushel of corn, and more than a pound in every bushel of wheat. This means that the corn grower and the wheat grower cannot afford to buy nitrogen, but must depend upon a rotation in which occurs one or more of these legume crops as full crops and as catch crops to be plowed under in order to maintain the supply of nitrogen in the soil. To be assured of success in the growing of these legumes, we must know that the soil contains the proper bacteria (the same bacteria will not produce nodules upon all legumes) and we must know that these bacteria will not develop well in a sour or acid soil; indeed, some of them will develop scarcely at all under these conditions. If the soil is sour, an application of fine ground limestone or air-slacked burnt lime must be made to destroy this sourness. Limestone is here not a food for the plant, but it makes the conditions such that the bacteria can develop and supply the plant with nitrogen, which will be added to the soil in the crop residues or in the crop which is turned under. The other two elements, phosphorous and potasium, are both mineral elements coming from the soil itself, and no rotation nor the growing of any particular plant can increase the total stock of these elements. The most that may be done is to bring about a transformation which will make them more available to succeeding crops. The only way in which we can increase the existing supply of either of these elements is to buy some material which contains the element and apply this to the soil.

We know that when we grain farmers remove one hundred bushels of corn from an acre of ground, leaving the stalks on the ground, we are taking away from that acre one hundred pounds of nitrogen, seventeen pounds of phosphorous, and nineteen pouds of potassium. We cosider it good farming when, by means of improved seed, good rotation, and good cultivation, we can take off one hundred bushels of corn from an acre; and so it is, but we want to go a step farther; we want to know if this system is always going to maintain itself; will it always be possible to get, annually, such amounts of plant food out of an acre of ground? Let me say that two-thirds of the nitrogen, three-fourths of the phosphorous, and one-fourth of the potassium necessary to produce the whole corn plant are in the grain, the part sold from the farm in grain farming.

We have seen that a rotation including sufficient clover or other legumes will solve the nitrogen part of the problem for us. This rotation does still another important thing. It is the means of keeping the supply of organic matter or decaying vegetable matter in the soil. Chopping up and turning under corn stalks, as well as getting back into the soil all of the oat and wheat straw, aid in this respect. This organic matter is one of the things which are most easily worked out of the soil by a system of grain farming in which cereals alone are grown, and in which stalks and straw are burned. At the same time, it is a most important factor in the productive power of a soil. It keeps the soil porous and well aerated, in a good workable condition, it improves its moisture holding capacity so that it will not suffer from drouth to the same extent as the soil low in organic matter; it tends to prevent surface washing, which is an important consideration on the more rolling lands in this State, and by its decay it breaks down the minerals of the soil containing the elements of plant food phosphorous and potassium, and so putting these in such a form that the plant can get them. In short, organic matter obtained largely and most easily by means of a good rotation, is a very important means in the hands of the land manager whereby he is enabled to get out of the soil the things of which crops are made. It is the business of the farmer then to see to it that his soil is well supplied wih these minerals containing phosphorous and potassium, and then, by a practical system of farming, to work out each year an amount sufficient for large crop yields.

I want to make some very general comparisons between Illinois soils and Missouri soils, to show, roughly, the location of similar types in the two States. In general, our soils, as are yours, are glacial or loessial in character. We have in the southern part of Illinois in twenty-five counties east of St. Louis, a so-called "white clay." This is a gray silt soil, usually ocupying flat areas, is not naturally under-drained, its subsoil being more or less nearly impervious. The lighter and more level prairie soil of Northeast Missouri is evidently quite similar to this soil. In the extreme southern part of Illinois we have seven counties of an unglaciated, but loess-covered soil. This is a reddish yellow silt loam and occupies more or less broken land. You have considerable of this kind of soil south of the Missouri river; it is locally called "red clay." Then, in northwest and north Central Missouri, you have in the darker prairie soils types very similar to the corn belt soils of Central and Southern Illinois. The most common type is a gently rolling brown silt loam, naturally well surface-drained. In addition there are in Illinois, and possibly in Missouri, larger or smaller areas of peaty swamp soils and sandy soils. These similarities are, of course, very general. I think that it will be well for have them in mind, however, while we consider some definite results obtained on Illinois soils.

In our State during the last four years, we have analyzed chemically hundreds of samples of these different types of soils; we have grown crops upon them as they exist in twenty-five different parts of the State, and we have grown crops upon smaller amounts of the soils in the pot-culture laboratory at Urbana. As general results, we find in the gray silt loam and in the brown silt loam enough potassium in the first seven inches of each acre to grow a hundred bushels of corn each year for more than a thousand years, and the supply increases as we go into the subsoil. On the other hand, on the brown silt loam sixty, and on the gray silt loam forty, such crops of corn would require as much phosphorous as is contained in one acre to a depth of seven inches, and the stock decreases as we go down. In the field, the application of potassium on the brown silt loam does not affect the yield of corn, but steamed bone meal, supplying phosphorous, increases the yield from ten to eighteen bushels per acre. On the gray silt loam, which is naturally a wheat soil rather than a corn soil, the same application of steamed bone meal gives an increase of ten to twenty bushels in the yield of wheat. On these soils, comprising about eighty per cent of Illinois soils, phosphorous is the limiting element of plant food; that is, when the season, the rainfall, the rotation and the seed used are such as to insure a maximum crop, the shortage on phosphorus may hold the yield down. In peaty swamp soils, on the other hand, the supply of potassium is short, while the phosphorus content is almost twice that of the brown silt loam. Field results on this soil show no increase from the use of steamed bone meal to supply phosphorus, while $2.50 worth of potassium sulphate has increased the yield from less than ten to sixty and seventy bushels of corn per acre. (See plate one.)

In the sandy soils and on the red silt loam hill land we find, by chemical analysis, still another condition, a shortage first of all in nitrogen. On these soils dried blood to supply nitrogen or legumes plowed under, thus drawing upon the atmospheric nitrogen, increases the yield. By this means alone the yield of corn has been increased from twenty-five or thirty bushels to fifty and sixty bushels. Neither phosphorus nor potassium alone affects the yield of corn on these soils. But after the yield has been brought up to fifty and sixty bushels by the use of legumes, as clover or cowpeas, then it tis likely that phosphorus, which is somewhat low, can be profitably used. In fact, steamed bone meal will now increase the yield of wheat profitably upon the red silt loam.

It is esential, then, that we have some knowledge of the plant food content of our soils, which may limit the crop yield and then adopt and follow a system of farming which will maintain, and, when necessary, increase the supply of any element.

Let me call your attention to the results of different systems of farming, as obtained upon the brown silt loam of the Illinois corn belt. Some of these fields have been under definite experimentation for twenty-seven years.

The figures showing the yields, all represent the average of the last three seasons, with the exception of the forty-three bushel yield, which is the average of two corn crops during the past three seasons, and the fifty-nine bushel yield, which is for the single year 1904. The 1904

TABLE NO. I.

Latest corn yields from the University of Illinois Soil Experiment Fields at Urbana.

Crop rotation practiced.	Soil treatment applied.	Bushels corn, 3 year average.
Corn 27 years, 1879-1905	None	25
Pasture 16 years, corn 11 years	None	42
Corn and oats, 27 years	None	43
Pasture 16 years, corn and oats, 11 years	None	57
Corn, oats and clover, 27 years	None	59
Pasture 16 years, corn, oats and clover 11 years	None	77
Same as above	Lime	78
Same as above	Lime and phosphorus	89
Same as above	Lime, phosphorus and potassium	91

yield with the same rotation started 16 years later, was seventy-five bushels (77 bushels for three-year average). The figures at the top of the table show how comparatively easy it is to lower the producing power of a soil. These plots are on good land, well surface drained, and tile drained. They are all in a twenty-acre field of naturally uniform land; they were planted at the same time with the same good seed corn, received the same cultivation, and were subject to the same seasonal conditions, the only difference being in the rotation practiced and, on some of them, in the treatment applied.

You will notice the varying yields resulting, first, from following the three rotations—continuous corn, corn and oats, and corn, oats and clover—second, from continuing these same rotations sixteen years longer on one set of plots than on the other. Let me call your attention in particular to the effect of this very desirable rotation, corn, oats and clover, upon this soil. It is quite commonly thought that such a rotation will indefinitely maintain the producing power of a soil. The facts do not show this, however, for, where followed for eleven years, this rotation has given a yield of seventy-seven bushels as an average for the last three, but where this same rotation has been followed for sixteen years longer, the yield has been reduced to fifty-nine bushels. To be sure, strictly grain farming has been followed upon these plots, no stock has been fed and no manure has been returned. But it is upon the subject of grain farming that I have been asked to speak. Let me say, that we have yet to find a soil in Illinois whose producing power can be indefinitely maintained by crop rotation alone. A rotation in which we have such a crop as clover producing larger corn yields is simply a means of getting more plant food out of the soil, and so running out the faster the supply of the limiting plant-food element. Where we have followed the three-year rotation and have added lime to give us better clover, corn has yielded seventy-eight bushels; the soil is not sour to any marked degree. On the next plot to which steamed bone meal has been applied, the yield gave but two bushels more. Both of these applications have cost annually seven bushels of 35 cent corn. In the case of the phosphorus plot, we have paid for the treatment, and have four bushels of corn clear profit. The important thing here, however, is not this profit for this year or for next year, but it is that the two-hundred pounds of steamed bone meal applied carried phosphorus enough to grow 100 bushels of corn, and we have taken off but eighty-nine.

Plate 2.—Clover after Oats with Lime Treatment.

Under this system, not only is the supply of the limiting element phosphorus being increased, thereby building up the soil, but at the same time an actual profit is being returned. The fact is, there is nearly always profit in a system of soil management whereby the productive capacity is gradually and permanently increased. On the other hand, there is ultimate loss in a system which destroys the productive power of a soil, a system on account of which the yield gradually becomes smaller.

On this same soil, on June 7, 1905, five plots, without phosphorus, yielded on the average one and one-quarter tons of field-cured clover hay, while five plots, to which phosphorus had been applied, averaged at the same time a little over three tons per acre (See plates 2 and 3.) Clover is a heavy feeder upon phosphorus, and it is specially benefited by an application of steamed bone meal or other carrier of phosphorus. In fact, the effect produced by clover upon succeeding corn crops upon this type of soil is not due entirely, or even largely, to the nitrogen thus added to the soil, as is commonly supposed, but is rather due to the fact that, by the decaying of the clover roots and the second growth turned under, large amounts of the soil's phosphorus are made available for the following crop. We know this because where we apply nitrogen alone in good form, as is dried blood, we do not get an increased yield, while phosphorus by itself will increase the yield.

Plate 3.—Clover after Oats with Lime and Phosphorus Treatment.

TABLE NO. II.

Crop yields in Illinois soil experiments. Odin field, four year rotation, legume series.

Soil treatment applied.	Average of 2 series each year.		
	1903 wheat, bu.	1904 wheat, bu.	1905 wheat, bu.
None	1	7	13
Legume catch crop	1	7	18
Legume, lime	1	10	24
Legume, lime, phosphorous	10	22	36
Legume, lime, phosphorus and potassium	15	25	32

Value of increase and cost of treatment

	1903.	1904.	1905.	Total for 3 years.	Cost for 3 years.
For legume	....	....	$3 50	$3 50	....
For lime	... .	$2 10	4 20	6 30	$1 50
For phosphorus	$6 30	8 40	8 40	23 10	7 50*
For potassium	3 50	2 10	2 80	2 80	7 50

*In steamed bone-meal.

Notice now, if you will, the effect of treatment on the gray silt loam. (See plates 4 and 5.) The particular field, the results of which are given here, is located at Odin. A four-year rotation of corn, oats, wheat and cowpeas has been followed. For legume treatment catch crops of cowpeas are seeded in the corn at the last cultivation and after the oats and wheat, to be plowed under for the benefit of the land. It should be stated that 1903 was a very poor wheat year, but notwithstanding that fact, phosphorus increased the yield nine bushels. In 1904, and again in 1905, where lime had been applied to destroy the sourness in this soil, legumes did better, and there was more organic matter to plow under, and the increased yield shows the effect. But phosphorus added to this treatment gave a very decided additional increase (12 bushels in 1904 and 12 bushels in 1905).

Plate 4.—Wheat Crop with Legume and Lime Treatment.

The one increase of twenty-three bushels in 1905 for the lime-legume-phosphorus treatment (from 13 to 36 bushels), has more than paid for the whole three years' treatment. Two tons of fine ground limestone, costing now about $2.25 per ton, were applied in the beginning (this application should keep the soil in good condition for growing clover during the next five or six years, when another ton may be needed), and the steamed bone meal has cost $2.50 each year, making $12 as the total cost of treatment, while the value of the twenty-three bushels for 1905 alone, at 70 cents per bushel, is $16.10. In addition to this we have the increase of nine bushels for 1903, and of fifteen bushels for 1904, as clear gain. But most important of all is the fact that we are putting on more than we are taking off in crops, and the soil is getting richer.

Plate 5.—Wheat Crop with Legume, Lime and Phosphorus Treatment.

Let me call your attention to the decreasing effect of potassium. We have an abundant natural supply in the soil, but not much decaying organic matter to make it available. But where the rotation has been followed and more and more organic matter worked into the soil, the effect of adding available potassium decreases from five bushels for the first year, three for the second, to an actual loss of four bushels for the third. The potassium is there in very large amounts, and it is better farming to work it out than it is to buy it.

TABLE NO. III.

Crop yields on Illinois soil experiments. From Vienna Field on Worn Hill land.

Soil treatment applied.	Bushels per acre.		
	1903 corn.	1904 corn.	1905 corn.
None	9	31	38
Legume catch crops	5	36	43
Legume Lime	8	49	62
Legume, lime, phosphorus	7	49	57
Legume, lime, phosphorus and potassium	11	45	57
Gain for legume, lime		18	24
Value of increase		$6 30	$8 40
Soil treatment applied.	**1903 wheat.**	**1904 wheat.**	**1905 wheat.**
None		7	1
Legume catch crops	1	7	11
Legume, lime	1	10	18
Legume, lime, phosphorus	8	15	26
Legume, lime, phosphorus and potassium	11	18	30
Gain for legume, lime and phosphorus	8	8	25
Value of increase	$5 60	$5 60	$17 50

Upon this red silt loam occupying the worn hills of the extreme southern part of the State, the growing of legumes to increase the nitrogen content of the soil, is of first importance. An acid condition exists here as well as in the gray silt loam, and the use of from one to two tons of fine ground limestone is advisable in order to get clover to stand and to grow better cowpeas. The first year the season was the limiting factor in production, but in the second and third year the legume and lime treatment has given a substantial increase in corn; neither phosphorus nor potassium added to this has increased the yield. The supply of phosphorus is rather low and, undoubtedly, when the nitrogen supply has been brought up, by turning under legumes, phosphorus can then be used with profit. In fact, for the wheat crop, phosphorus can be profitably used from the beginning, as is shown by the increase of seven bushels the first year, five bushels the second, and eight bushels the third.

Allow me to say a word in regard to another good form in which to buy the element phosphorus; that is in the form of fine ground natural rock phosphate. This material is being taken in large quantities from the mines of Tennessee and other Southern states, and do you know that two-thirds of the yearly output, or 1,000,000 tons, are being exported? The farmers of England and Germany know that it takes phosphorus to produce grains profitably. Most of the output which remains in this country is being manufactured into acid phosphate and then into complete fertilizers. These materials are being used in the eastern states where today we have abandoned farms. They act merely as supplements to the plant food in the soil and as soil stimulators. The cost of manufacture makes the cost of the plant food elements so high, especially in socalled "complete fertilizers," that the grain farmer cannot afford to replace, by their purchase, the plant food removed in crops. Then, too, the added acid will, in many cases, only intensify our already unfavorable conditions for clover growing. But in the form of steamed bone meal or natural rock phosphate, enough phosphorus can be bought and profitably used to more than replace the phosphorus removed in large crops. About $25.00 in the one case and $8.50 in the other, will buy a ton of material-carrying phosphorus enough for more than 1,000 bushels of corn or wheat. These materials will not injure the soil, indeed, we have the rock phosphate naturally in the soil. To be sure, the phosphorus in the ground rock phosphate is not readily available, neither is the stock of phosphorus in our soils available, but they can both be made available by decaying organic matter, and I think it is the business of the farmer to do this. Rock phosphate will not give results upon thin worn soils by itself, it must be turned under with farm manure, second growth clover, or anything which will supply decaying organic matter.

In this matter of looking after the plant food supply of our soils, we do not believe in letting others do for us that which we can as well do for ourselves. We believe that it is good farm practice and good business to use the natural raw materials at hand, to draw upon the immense supply of nitrogen in the air by means of legumes, and, if we are short in one or more of the mineral elements, to get these in the cheapest form possible, apply them to our soils in large excess of crop needs, and then to see to it that we work them out by means of decaying organic matter.

I am sure, gentlemen, that if we will study earnestly this matter of the productive power of soils, we will be able to adopt systems of farming upon the soils of Missouri whereby we can continue to do grain farming, do it profitably, by building up our soils, and at the same time establish here, and in all of this great Central West, a permanent agriculture.

EXPERIMENTS WITH COMMERCIAL FERTILIZERS.

(Prof. H. A. Huston, Chicago, Ill.)

The last speaker has relieved me of the necessity of making any extended explanation in regard to some of the principles involved in the use of commercial plant foods. We may pass directly to our subject, and perhaps it may be helpful if we spend a few minutes in considering what the crops remove from the soil, using the wheat plant for an example.

A bundle of. wheat as it leaves the binder, contains, in addition to a variable amount of water, about 10 pounds of material. By a particularly fortunate provision of nature, the most of this material is derived from air and water. We may make a rough separation by burning the bundle. Most of it passes off in the form of gases or smoke, and of the ingredients burned all, with one exception, to which we will refer again, were derived from the air and water. There remains a small quantity of material, commonly called ash, and while it is small, both in bulk and weight, as compared with the whole bundle, being only about 3.5 per cent, or one-third, of a pound to the bundle, it is none the less important. There are nine substances present in this ash, which are found to be needed by the plant; two of them, chlorine and soda, are, perhaps, of less vital importance to most plants, but the others are surely essential to normal plant growth. The quantities of all of these mineral ingredients in the bundle of wheat are shown in these vials, in the form of familiar compounds. For our present purposes we might set aside the silica, iron, magnesia, soda, sulphur and chlorine, since every ordinary soil will furnish these in abundance, and they are never applied as plant foods, and when present in fertilizer mixtures no money value is attached to them. The same is true of lime, which is never applied to land for the purpose of furnishing plant food, although it is frequently used to great advantage in correcting acidity and in improving the mechanical condition of heavy soils. Used alone, its final effect is soil exhaustion.

There remain two substances which are found in relatively large quantities in the ash and are found in most soils in limited amounts and unavailable forms. The first of these is phosphoric acid and the second is potash. These constitute two of the three so-called essential plant foods; not because they are really more necessay than the others, but because of the plant's demand for a large amount of them and because of the plant's difficulty in getting them from the relatively insoluble compounds in which these two substances occur in soils.

You are all familiar with the substance obtained by chewing wheat; this we often call gum, but it is really gluten, a substance containing nitrogen and sulphur in addition to the elements contained in starch and cellulose. The quantity of nitrogen in the bundle of wheat (shown here in the form of one of its most concentrated compounds, sulphate of ammonia), is quite large and the amount of it in most soils is not large and is subject to constant loss by leaching, as well as by removal in crops. Hence, this element is referred to as an essential plant food.

These three substances, nitrogen, phosphoric acid and potash, the so-called essential plant foods, must be furnished to agricultural plants in the right amounts, in the right forms and at the right times if we are to make a proper use of our soils.

It is true, that a chemical analysis can show the total amount of plant food in any soil, but very little of this is available at one time or in one season. Moreover, the plant is like the rest of us, it gets its food as easily as possible, and so takes the most available plant food first.

A little of the plant food in the soil is available, a part can be made available in a reasonable time, but the most of the mineral elements are in such a condition that by no known means can they be made available in a reasonable time or at a reasonable cost. It is only an irritation to the farmer to learn that there is enough potash in his soil to raise one thousand corn crops and then to find out that it will not become available in ten thousand years.

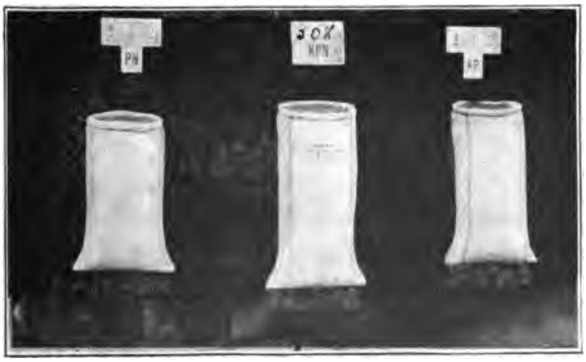
Improved tillage can do much to make soil nitrogen more rapidly available, but can do little to increase the rate at which the more resistent compounds of phosphoric acid and potash change into available forms.

Of course, the manurial resouces of the farm in the form of manures and leguminous crops should be utilized to the utmost. But the use of these will frequently fail to make good some marked soil deficiency which is limiting the crop. This lack may be due either to the origin of the soil or to a system of cropping whch has removed nearly all of the available supply of one or more elements and left the soil in a condition in which it will no longer yield profitable crops. Often a liberal use of minerals is necessary to produce a crop of the legume on which we depend for the increase of the nitrogen supply.

Hence, it very often happens that in spite of the great stores of total plant food in some soils, the application to them in an available form of what seems a trifling amount of plant food, produces most striking and profitable returns. The way to find out whether fertilizers can be profitably used is to try it. But it is essential that one should start right in making such a trial. One should use known quantities of standard plant foods and not manufactured brands in the trials. Having found out what is needed, one may turn his attention to whether he prefers to buy it in ready mixed form or otherwise.

Your attention is first called to a wheat experiment on land which once was fine wheat soil, but has been run down by a bad system of cropping. The facts about the wheat test are:

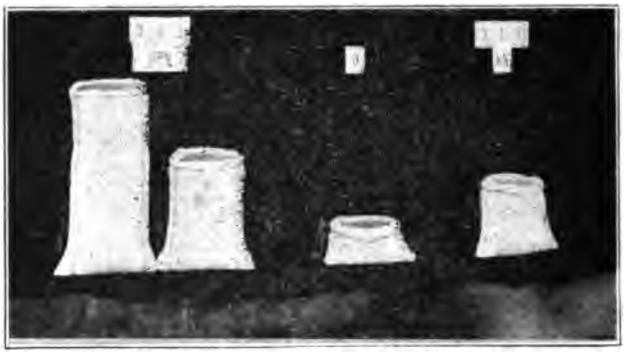
	Fertilizer per acre.	Yield per acre.	Cost of fertilizer.	Value of increase.	Profits.
Plat O............	None.........	4.2 bushel.	....	....	....
Plat 311...........	Blood, 60 pounds.. ...... Muriate of potash, 30 lbs	9.5 bushel.	$2.25	$4.24	$1.99
Plat 312	Blood, 60 pounds.......... Acid phos., 200 pounds.	21.3 bushel.....	3.00	13.68	10.68
Plat 313............	Acid phos., 200 pounds... Muriate of potash, 30 lbs.	22.6 bushel.....	2.25	14.72	12.47
Plat 307.......	Blood, 60 pounds.......... Acid Phos., 200 pounds. Muriate of potash, 30 lbs	30.8 bushel....	3.75	22.88	19.13
Plat 308.....	Blood, 60 pounds.......... Acid Phos., 200 lbs. Muriate of potash, 15 lbs.	24.8 bushel.....	3.38	16.48	13.10



COMPARATIVE YIELDS OF WHEAT FROM ⅒ ACRE.

Fertilizer Used.

1st Sack.	2nd Sack.	3rd Sack.
Acid Phosphate. Blood.	Blood. Acid Phosphate. Muriate of Potash.	Acid Phosphate. Muriate of Potash.



COMPARATIVE YIELDS OF WHEAT FROM 1/10 ACRE.

Fertilizer Used.

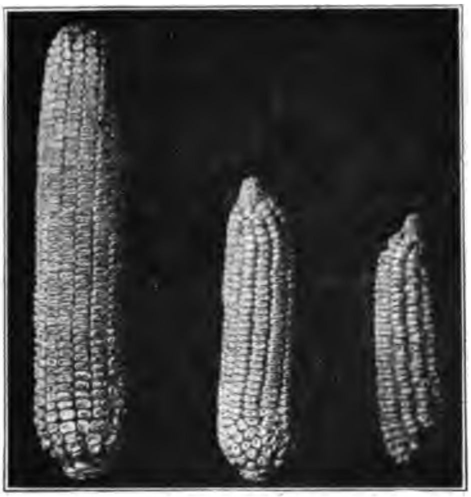
1st and 2nd Sacks.	3rd Sack.	4th Sack.
Acid Phosphate. Blood. Muriate of Potash.	None.	Blood. Muriate of Potash.

This work was done by a farmer in the ordinary way. The profits ranged from 88 to 510 per cent. A rather instructive lesson is brought out by comparing plats 312, 307 and 308. The addition of 30 pounds of muriate of potash increased the yield 9 1-2 bushels at a cost of 75 cents, or less than 8 cents per bushel. Where only 15 pounds of muriate of potash was used, the yield was only increased 3 1-2 bushels, at a cost of 38 cents, or 11 cents per bushel. The farmer saved 37 cents worth of fertilizer and lost 6 bushels of wheat. This illustrates a well-known law that if too little potash is used the straw gets it away from the grain.

In terms of mixed fertilizer the experimenter used, on plat 307, 300 pounds per acre of a fertilizer containing 3 per cent nitrogen, 9 per cent available phosphorc acid and 5 per cent potash. On plats 311, 312 and 313, one ingredient is left out.

The profits are large, but not greater than can be expected when the right kinds, amounts and forms of plant food are used. Many farmers use from 75 to 150 pounds of a one-sided low grade fertilizer and increase the straw, but do not use the right amount or kind for the highest production of grain.

The experiments with corn are simpler, containing only three plats.



EXPERIMENT AT MARIONVILLE, MO.

Fertilizer Used.

1st Ear.	2nd Ear.	3rd Ear.
Bone. Blood. Potash.	Bone. Blood.	None.

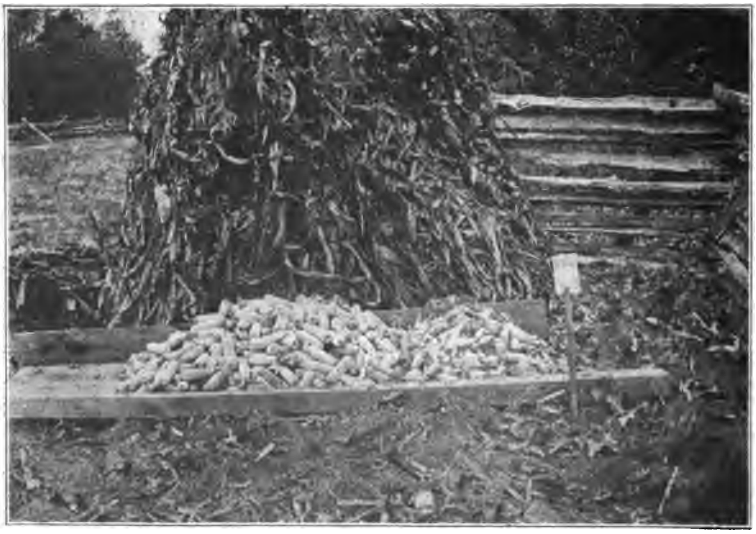
EXPERIMENTS AT MARIONVILLE, MO.

	Fertilizer per acre.	Yield per acre.	Cost of fertilizer per acre.	Value of increase.	Profit.
Plat 1........	None..............	20 bushels......	....	....	....
Plat 2..............	Blood, 188 pounds......... Bone, 336 pounds.	29.3 bushels....	$8 50	$4 66	Loss
Plat 3...	Blood, 188 pounds.......... Bone, 336 pounds. Sulphate of potash, 120 pounds.	49.6 bushels....	11 70	14 80	$3 10

EXPERIMENT AT RAYMONDVILLE, MO.

Plat 1..............	None.......................	16.8 bushels....	....	....	....
Plat 2.........	Blood, 170 pounds......... Bone, 300 pounds.	24.2 bushels....	$8 34	$3 70	Loss
Plat 3....	Blood, 170 pounds.......... Bone, 300 pounds. Muriate of potash, 120 pounds.	47.2 bushels....	12 06	15 20	$3.14

EXPERIMENT AT RAYMONDVILLE, MO.
Yield from Plot No. 1. No Fertilizer Used.



EXPERIMENT AT RAYMONDVILLE, MO.
Yield from Plot No. 2. Blood and Bone Fertilizer Applied.

We have selected these two experiments on corn not because they show the most striking profits, but because they show the necessity of using the right things, at the right time, in the right amounts, and in the right forms. Both bone and blood are excellent forms of plant food for some purposes. But bone acts too slowly for corn, and the high expense of the blood is not justified by the corn crop. The corn could not utilize the slowly available bone in its short growing season. The corn needed something more than bone and blood, as shown by the great increase when the potash was added. The potash cost $3.00 per acre and increased the yield 20 and 23 bushels, and converted a loss on the blood and bone into a gain of 25 per cent on the cost of the whole fertilizer, and a gain of 360 per cent on the cost of the potash.

The amount of fertilizer used in these corn experiments was too large, the phosphoric acid was not in the right form, and in plat 2 the most important ingredient is lacking.

On plat 3, doubtless, even better results would have been obtained had the phosphoric acid been in a more available form.

A striking thing about the corn from Marionville is that the corn from plat 1, unfertilized, has been practically destroyed by the insects that bore through the kernels, that form plat 2, partially fertilized, has been attacked some and that from plat 3, fully fertilized, shows very little damage from the insects. The corn from the three plats has been kept in the same box since harvest.

EXPERIMENT AT RAYMONDVILLE, MO.

Yield from Plot No. 3. Blood, Bone and Potash Fertilizer Applied.

Properly used, commercial plant foods may be very profitably used to supplement the manurial products of the farm. If you wish to devote more time to the matter this morning, it may be better to do so in discussion of questions which you may see fit to ask.

THE PRODUCTIVE CAPACITY OF FIELDS AS INFLUENCED BY SOIL MANAGEMENT.

(Prof. F. H. King, Madison, Wis.)

The management of soils to establish, to increase and to maintain a high productive capacity of fields is one of the oldest and most extensively practiced arts of industrial life. Most barbaric and all civilized people have fostered it. No other art or trade engages the attention and absorbs the energies of so many families.

With the vast and ever increasing demands made upon the materials for food, for apparel, for furnishings and for cordage, which are the products of cultivated fields, better soil management must grow more and more important as populations multiply. With the increasing cost and ultimate exhaustion of mineral fuels; with our timber vanishing rapidly before the ever growing demands for lumber and paper; with the inevitably slow growth of trees and the very limited areas which the world can ever afford to devote to forestry, the time must surely come when, in short period rotations, there will be grown upon the farm the materials from which to manufacture, not only paper and substitutes for lumber, but fuels as well. Not the complete utilization of the power of every stream which reaches the sea, reinforced by the force of the winds and the energy of the waves which may be transformed along coast lines can meet the demands of the future for power and heat; and hence only in the event of science and engineering skill becoming able to devise means for transforming the unlimited energy of space through which we are ever whirled, with an economy approximating that which farm crops now exhibit, can good soil management be relieved of the task of meeting a portion of the world's demand for power and heat.

While the lands which may be laid under tribute by good soil management, to augment future supplies, extend from the shore lines of the sea to the snow lines of the mountains and of the polar zones; each year they are becoming unavailable by hundreds of square miles through the expansion of cities and the multiplication of homes and summer cottages; through the extension of railways, trolley lines, canals and highways; and through their appropriation for military uses and park reserves. To meet the rapidly increasing demands upon these inevitably decreasing areas, the methods of soil management must be improved; the underlying sciences, in their relation to it, must be developed and the practices squared to their laws and teachings just as in great commercial, mining and manufacturing industries these have been and are being squared to theirs. This can only be effectively done through organized effort directed by that training and experience which the complex and difficult nature of the problems demand, but which no body of farmers has ever been or can be expected to become able to command. Those industries, which from their nature, can syndicate large amounts of capital in their interest may and do, economically and effectively, command scientific methods and skill for the express purpose of developing those underlying principles which good business men are quick to recognize as indispensable to commercial success. But in agriculture, only a few of its commercial and manufacturing phases are any of these means of improvement available, and hence the extreme necessity for and the appropriateness of government aid in bringing to a working basis the knowledge of the underlying principles of soil management and of leading phases of other agricultural practices.

Up to the present time the burden of effort has been expended in developing the commercial and manufacturing phases of agriculture rather than upon those conditions which determine and maintain a high productive capacity of the soil. Such an evolution has been natural, rational, and up to the present time, perhaps, most advantageous; but we are fast approaching that stage when it will become of the greatest importance, not that less attention shall be given to advancing the manufacturing and commercial phases of agriculture, but when much more and effective effort must be given to those conditions which tend to increase the yield per unit area on all types of soil.

Universally, the world over, under all climatic conditions and for all types, the bad management of soils has been found to greatly reduce their productive capacity, the fall often being, for some crops, to as low as one-fifth of the virgin productive power. Such great reductions, too, have generally been effected in comparatively brief periods, often during the life and management of a single man. Within my own personal experience, and doubtless within that of many of you, inherently rich soils whose normal productive capacities ranged from 30 to 45 bushels of wheat have been reduced, by faulty management, to 15 and even as low as 8 bushels per acre; and this during a period of cropping covering much less than fifty years. Reductions in productive capacity like these are not due to changes in climate, in cultural methods, in potency of seed, in varieties of wheat, nor to changes in any other outside conditions; they have resulted from profound, but as yet not well understood, alterations within the soil itself; from changes which a sufficiently early knowledge and care in its application undoubtedly could have averted.

The mean yield of wheat in the United States during the last ten years of the century just closed was only 13.2 bushels per acre, scarcely one-third, certainly not one-half, what the normal virgin capacity of the soils once was. From nearly 40 million of acres in wheat, which should have yielded between 1,000 and 1,500 million bushels per annum, we have realized but little over 500 million bushels. Instead of gross earnings which should have amounted to 650 to over 900 million dollars annually there has been realized only 330 million dollars, an annual shortage of the wheat crop alone large enough, could it have been averted, to give to each of the 48 states and territories between 7 and 14 million dollars each year of that decade. To put greater emphasis upon this enormous shrinkage in productive power let me say that during the period under consideration the mean yield per acre of wheat in Germany, where more attention has been devoted to the maintenance of soil fertility, was 26 bushels per acre and in the United Kingdom it exceeded 31 bushels. Notwithstanding the fact that in European Russia the mean yield of wheat has fallen as low as 9 bushels per acre, yet the aggregate wheat product of Europe, according to statistics, exceeded that of the five other continents by as many as 292 millions of bushels, and this, too, notwithstanding the long time those fields have been under cultivation and notwithstanding the fact that the United States had ten acres in wheat for every square mile of surface in all Europe. Moreover, with Europe's large output of wheat she produces at the same time, of oats, of barley and of rye nearly fourfold the crop grown in North America; the figures standing 4,362 million bushels for Europe against 1,099 millions for North America. Even when we combine the yields of wheat, oats, barley and rye grown in North America with our great staple, corn, the total output aggregates but 3,965 millions of bushels, as compared with 6,413 millions harvested each year in Europe.

To maintain a high productive capacity in soils which are normally rich; to restore this capacity again to those in which it has been reduced; and to materially increase the yield in soils which are naturally poor, is clearly a matter of the highest order of national concern. Only when this has been done does it become possible to secure the largest returns from the best cultural methods; from the most improved breeds and strains of either plants or animals; or from a full extension of commercial and manufacturing methods for the disposal of agricultural products. The selection of crops with special reference to their adaptation to certain types of soil; to climatological and to market conditions; to the development of drought, disease and insect-resisting strains; and the selection and care of seed are all important lines of procedure tending to increase yield; but back of and before these and all else is the soil itself, which must be carried to and maintained at the highest productive capacity before, either singly or in combination, the other lines of effort can yield their highest returns. If a hardy strain of wheat, for example, will increase the yield on a 13-bushel soil to 16 bushels per acre, on the same soil brought into a 26-bushel condition, the hardy strain of wheat ought here to increase the yield beyond three bushels per acre, making it 32 or more instead of 29 bushels. Where the yield of wheat on a given field has shrunk from 40 to 15 bushels per acre; where that of oats has shrunk from 70 to 20 bushels and that of corn from 80 to 25 bushels per acre, there is no reason to hope that the introduction of new varieties or the use of more vigorous seed will force the yield up to the old standards. The main help must be sought through the restoration of the old physical, chemical and biological conditions of the soil itself which will put the productive capacity inherent in the soil back where it was when the yields were high.

Having said this much, in a general way, regarding the great importance of more attention being given to the soil itself, I desire to bring to your consideration, as briefly but forcibly as I may, a few fundamental facts and principles which lie at the foundation and must direct all lines of effort aiming to secure higher yields from our fields through a better, more economical and more rational management of the soil.

There is nothing which can do so much, in a business way, for any line of industry as a clear, full understanding of the great facts and principles, which, if intelligently adhered to and applied, lead with certainty to the desired results. In illustration of what is here referred to let me call your attention for a moment to the manner in which the world's supply of nitrogen is maintained in the soil today and has been through unnumbered ages. For many years it has been known that green plants draw their main supply of carbon directly from the air in the form of carbon dioxide or carbonic acid gas. But it is only within the memory of the youngest in this audience that the real source of that very important element, nitrogen, has been made known to the agricultural world. The most careful observers and the most thoughtful practical men among the farmers of all countries and throughout all history had associated an observed increase of crop following the growing of different members of the clover family upon more or less exhausted fields. But they could see no necessary reason why the growing of clover on a field and the removal of the crop from the ground should give to it a higher productive power; and so, except where there was some other reason than that of improving the productive power of the field, there was no incentive to grow regularly in the system of rotation some one or another of the leguminous crops, like the clovers, alfalfa, lupine, cow peas, soy beans or sainfoin. For a long time it was held that the exclusive source of nitrogen for the higher plants was the organic matter of the soil, and this, too, notwithstanding the fact that it was continually being washed from the soil in the form of very soluble nitrates and carried to the sea and even escaping in large quantities into the atmosphere in the form of free nitrogen. When, finally, the matter came under rigid investigation by men of science, there followed a battle extending over years during which the opponents in the fray hurled against one another all the weight of experimental evidence, cogency of logic and massiveness of personal authority which they could command and there was a stage in the combat when it looked as though error would be securely seated on the throne of truth, when this conviction of many practical men would be relegated to the category of planting and butchering in the right phase of the moon. Indeed, it was true that the highest authorities of the time and the most careful and rigid experimenter, thinking and planning from a mistaken point of view, the more cautiously they moved and the more thoroughly they safeguarded their lines of attack to avoid the introduction of sources of error, the more unquestionably did their results appear to bear out the conviction, at that time thoroughly rooted, that none of the ordinary higher plants are able to add to their nitrogen supply from the air itself. But in the many repetitions of experiments which were conducted, particularly among those which, it was held by opponents, did not sufficiently guard against sources of error, there were found gains of nitrogen, and these led to looking at the problem from different points of view; and, while the conflict with its story was long, the real truth was finally brought into the light and we now know with the definiteness that twice two makes four that when a vigorous leguminous crop is matured upon the ground the soil is made absolutely richer by the addition of very considerable amounts of nitrogen extracted from the soil air by the microscopic organisms dwelling and feeding in the tubercles or nodules found on the roots of the vigorous plants of most, if not all, of the large clover-pea-vetch-bean family. And now that this great principle or method of adding the indispensable nitrogen to the soil has been demonstrated with absoluteness, farmers are able to proceed with the assurance of certainty rather than that of faith. The result is that a thousand apply the truth where one did before, and there is perhaps no discovery in all the wide realm of agriculture which will be able to do so much in the permanent winning of bread as this.

I wish now to emphasize for your stronger conviction three other very fundamental truths upon which enduring economic methods of soil management must forever rest. These are:

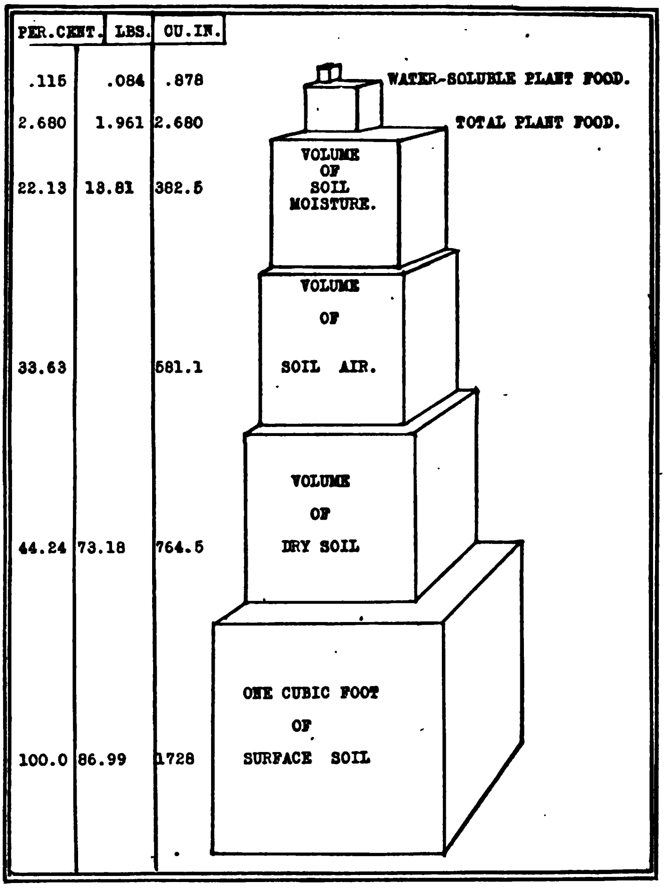


Fig. 1.—Showing the relative amounts of dry soil; soil air; total plant food and plant food materials soluble in water contained in one cubic foot of average surface soil in the United States.

1. The necessity for a sufficient amount of room in the soil, not only in the portion turned with the plow, but throughout the effective root zone.

2. The existence in the soil of large amounts of plant food materials, but not in available forms, and which it must become the business

of soil management to transform into available condition with sufficient rapidity to meet the need of heavy yields.

3. The necessity for an ample crumb-structure of the soil throughout the effective root zone which bad management breaks down and which good management builds up and renders more stable.

The urgency of an abundance of room deep in the soil is very great. In the first place, we do not sufficiently appreciate that the soil of a field is in reality a pasture upon the internal surface of which available plant food materials grow, through the mutual interaction of a multitude of soil organisms, organic matter, moisture, air and the roots of crops, living and decaying, all of them operating together to bring into solution the more insoluble forms of potash, lime, magnesia and phosphoric acid, so that when the roots of crops spread themselves out over the extensive internal surface, carrying a rich growth of soluble plant food materials, they find themselves in an ample pasture of nutritious feed, and growth is rapid. But the first great requisite of this pasture is room; broad surfaces upon which large amounts of water may be stored to become charged with dissolved plant food materials; over which organic matter may widely spread to constitute the feeding ground of those miscroscopic forms of life which turn its nitrogen and other plant food elements into forms available to crops; and these internal surfaces far enough apart to give strong and deep ventilation and ample space into which the roots may spread and find abundant opportunity to set the soil grains aside to make room for due enlargement.

Upon this chart there has been represented, by drawing to proper scale, the volume of the component portions of the surface foot of a soil possessing about the medium amount of room which is found in a soil of average productive capacity. The bottom cube in the diagram stands for a cubic foot of undisturbed surface soil, in its normal field condition when well settled toward the end of the growing season after having been plowed 6 to 7 inches deep in the spring of the same season. The second cube represents the volume the dry soil would occupy with the moisture and the air removed and with the soil so consolidated that all open spaces are obliterated. In this condition its volume would be 764.5 cubic inches or 44.24 per cent of the whole cubic foot. The dry weight of this soil is 73.176 pounds, while the dimension gives a cube a little more than 9 inches on each edge. The third cube on the chart represents the volume of the space in the foot of surface soil which is occupied by air when the amount of moisture present is very near the best amount for good crop conditions. In it there are 581.1 cubic inches of space occupied by air, comprising 33.63 per cent. That is, the surface foot of soil in good moisture condition possesses an amount of room through which air may circulate and in which the roots of crops may develop which is rather more than one-third of the entire volume expressed by a cube 8.3 inches on each edge. The volume of water carried in a cubic foot of surface soil is represented relatively by the fourth cube on the chart which contains 382.5 cubic inches or 22.13 per cent. of the whole volume and contained by a cube a little less than 7.3 inches on each edge. This amount of water represents nearly 2.66 inches in depth on the level over the surface, and if the space occupied with air were also filled with water the combined amount would overspread the surface to a depth of 6.69 inches.

There are few places in the United States where the amount, character and distribution of rain is such as to make maximum yields possible, and hence it is a matter of great importance that the roominess of the soil be maintained of such an amount and of such a character that whatever rain falls during the growing season may be quickly taken in without puddling the surface and without so completely filling the soil as to seriously check soil ventilation during any long interval of time.

Thorough underdrainage is the first requisite for developing and maintaining roominess and openness deep in the soil. Next comes a deep incorporation of organic matter through a rotation which includes clovers and grasses. The roots themselves open the soil and, carrying the organic matter into the subsoil, induce a deeper penetration of earthworms, ants and other burrowing animals. Moreover, the deep incorporation of organic matter assists the action of the frost and of shrinkage, due to drying, in developing the crumb structure which renders the openness more efficient. The occasional deep turning under of stable and green manures and of roughage of all kinds is extremely helpful; and it is not sufficiently appreciated that most organic matter is more efficient turned under than when left to decay at the surface.

AMOUNT OF PLANT FOOD CARRIED BY SOILS.

It is very important to understand that there is present in the soil a very large amount of the different plant food elements; that only a small portion relatively of that present exists in immediately available form; but that good and bad methods of soil management exert a very marked influence upon the rate at which the plant food elements present in the soil are transformed into the condition available to crops.

Taking Maxwell's complete analysis of a composite sample made up of soils from the grounds of many of the Experiment Stations in the

United States, and 73.176 pounds as the mean weight of a surface foot of soil, the following table gives the amount of the different essential plant food elements per acre, expressed in tons:

Tons, per acre, of essential plant food elements in the surface foot of soil:

Potash K Tons.	Lime Ca Tons.	Magnesia Mg Tons.	Nitrogen N Tons.	Phosphoric Acid P Tons.	Sulphuric Acid S Tons.
20	8.9	7.0	4.0	2.4	.6

These amounts constitute 2.68 per cent. of the dry weight of the soil and their aggregate volume is represented relatively by the fifth cube on the chart, 2.73 inches on an edge and weighing nearly an even 2 pounds for each cubic foot of surface soil. Thus it is seen that of the nearly 43 tons of essential plant food elements carried, about one-half is potash (K), one-fifth is lime (Ca), one-sixth is magnesia (Mg), one-twelfth is nitrogen (N), one-eighteenth is phosphoric acid (P), and one-eightieth is sulphuric acid (S).

But the effective root zone in any soil adequately underdrained and of the proper degree of openness is fully 3 to 4 feet in depth, and hence the roots of a crop may be spread out through a soil mass carrying 3 or 4 times the amounts of all of the plant food elements designated in the table above excepting only nitrogen, and in this case Warington found the surface four feet at Rothamsted to carry 5.2 tons per acre. Four thousand crops of wheat yielding 40 bushels of grain and 3,600 pounds of straw per acre will not gather from the soil as much potash, lime or magnesia as are carried in the surface four feet of soil. There is phosphoric acid enough for 1,100 such crops; sulphuric acid enough for 700, but nitrogen enough for only 155 such crops of wheat. Nevertheless, it must be remembered, that with more plant food even of nitrogen than will suffice for 100 such crops of wheat within the reach of roots beneath the surface of every field; with the rainfall, with the sunshine and with the temperature to a measureable extent unchanged; with better seed, better varieties, fuller knowledge, more efficient tools and higher skill in management the richest of our virgin soils have fallen from a productive capacity of 40 bushels of wheat per acre to one as low as 20 and even much less during periods so short as 25 years. What has been the cause of these shrinkages? Can the virgin productive capacity of such soils be restored? Can it be economically maintained if restored? If it can be economically restored and afterward maintained, then by what means and by what methods? These are the vital and fundamental problems of soil management.

AMOUNT OF WATER-SOLUBLE PLANT FOOD ELEMENTS IN SOIL.

We have tried to fix in your minds the very important fact that within the surface four feet of every well managed field there are carried, in the aggregate and on the average, something more than 120 to 160 tons of the essential plant food elements. We desire now to emphasize another even more important fact, namely, the great bulk of these large amounts of plant food elements is locked up in the form of substances which dissolve with extreme difficulty in water, and, while it is true that none of the plant food materials become available to crops until they are dissolved in the soil moisture, it is nevertheless fortunate that the great reservoir of plant food materials is filled with form so difficulty soluble. Were this not so, the percolation of rain through the soil would carry away so completely the plant food materials that even in regions of abundant rainfall the land would be deserts and only in the arid regions, where leaching cannot occur and where irrigation must be resorted to, could crops be grown without the heaviest and ever repeated applications of fertilizers.

The smallest cube represented on the chart shows, relatively, the aggregate volume of the essential plant food elements which were recovered from 8 soil types, 4 of which were good and 4 poor, by leaching quickly through thin layers of them 55 times their dry weight of pure water, a layer of water which would cover the surface to a depth of some 16 to 18 inches. This cube of plant food soluble in water derived from one cubic foot of surface soil is a little less than .1 of an inch on an edge; constitutes .1148 per cent of the dry soil, thus making a weight of a little more than half an ounce per foot of surface soil, and 3,660 pounds or 1.83 tons per acre. The amounts of the respective plant food elements so recovered are given in the next table.

Plant food elements removed from the surface foot of 8 soils with pure water:

Amount in pounds per acre of surface foot.

	Potash K.	Lime Ca.	Magnesia Mg.	Nitrogen N.	Phosphoric Acid P.	Sulphuric Acid S.
Good soil..........	663.5	2292.0	766.6	71.61	202.6	1116.0
Poor soil....	596.9	626.8	293.4	35.70	84.83	548.1

Number of crops of wheat required to remove the above amounts.

Good soil....... ..	22.7	293.8	286.3	1.1	17.3	241.6
Poor soil...........	20.1	80.4	101.0	.5	7.2	118.6

From this table it will be observed that there existed in the four good soils very much more of all the essential plant food elements in a form which could be recovered with pure water than were carried in the poor soils. In the aggregate the water-soluble plant food elements from the good soils exceeded those recovered from the poor soils more than 2.8 times, while the yield of corn and potatoes was nearly 2.5 times greater.

The figures given above refer to the surface foot only, but it must be remembered that the roots of crops penetrate the soil to a depth even greater than four feet; and further than this, through capillary movement of the soil moisture the dissolved plant food materials are carried from the fourth, third and second feet upward into the surface foot. Because of these relations the surface four feet of these 8 soil types were examined to determine the amount of the different plant food elements which could be recovered from them by treating them only 3 minutes in five times their weight of water. The total amounts so recovered are given in the next table.

Plant food elements recovered from the surface 4 feet of 8 soil types by washing but 3 minutes in 5 times their weight of pure water.

Amount in pounds per acre of surface four foot.

	Potash K.	Lime Ca.	Magnesia Mg.	Nitrogen N.	Phosphoric Acid P.	Sulphuric Acid S.
Good soils..........	264.8	1016.4	348.3	82.0	113.6	1379.0
Poor soils	182.4	395.4	177.4	30.2	64.3	388.6

Number of crops of wheat required to remove the above amounts.

	Potash K.	Lime Ca.	Magnesia Mg.	Nitrogen N.	Phosphoric Acid P.	Sulphuric Acid S.
Good soils.........	9.1	130.3	130.0	1.2	9.7	298.5
Poor soils.	6.2	50.7	66.2	.45	5.5	84.1

Here again it is seen that the good soils have yielded to the 3-minute washing in pure water more of the essential plant food elements than the poor soils did, and also more than enough from the surface 4 feet of soil of each and every element for a crop of 40 bushels of wheat and 3,660 pounds of straw per acre. Indeed, there was recovered of both potash and phosphoric acid enough for 9 such crops; and there is little doubt but that if the washing of the same samples had been repeated 11 times in corresponding amounts of water, as was done in the first series cited, nearly 11 times as much of these two elements would have been recovered; and we see that while the plant food elements carried in soluble form in soil is small in comparison with the amounts present which are not readily soluble in water, these forms are nevertheless large in the good soils and in the surface four feet enough of all except nitrogen for many large crops, could it all be used.

It is not sufficiently appreciated, although it should go without saying, that a strong soil moisture solution, well charged with all the essential plant food elements, making it a thoroughly balanced ration for the crop growing upon the field, is indispensable to large yields. Indeed, just as in the case of growing and producing animals, the body must be kept charged with blood rich in all that is essential to increase, so it must be with crops; their sap must be loaded and to spare with everything that makes for growth; and just as a rich blood can only be maintained out of a rich solution in the alimentary canal, ever reinforced by good air, so a strong plant sap can only be continuously supplied to the crop when its roots are ever immersed in a soil solution rich in all that is needed, and well aerated. The next table shows how different was the plant sap in the crops growing on the good and on the poor soils.

Amount of plant food elements in the sap of plants, per equal areas, growing on good and on poor soil:

	Potash K. lbs.	Lime Ca. lbs.	Magnesia Mg. lbs.	Nitrogen N. lbs.	Phophoric Acid P. lbs.	Sulphuric Acid S. lbs.	Total lbs.
Good soil... ...	126.3	19.0	21.0	21.5	11.8	5.5	205.1
Poor soil........	47.9	3.7	3.5	3.1	4.6	1.3	64.1

From this table it is seen that the same number of plants, growing upon an equal area of good soil, were able to take up from the soil through the soil moisture in the same time nearly three times as much potash, as measured by the amount contained in the plant sap, over 5 times as much lime, 6 times as much magnesia, 7 times as much nitrogen, more than double the amount of phosphoric acid, and 4 times the amount of sulphuric acid. Associated with this stronger nutritive solution in the soil, and with the sap of the plants richer in the elements which contribute to growth, there was a yield nearly 2.5 times on the stronger soil than that which developed on the poorer soil.

We have reason to think that, in the ultimate analysis, an exhausted soil is one in which it has become impossible for natural processes to maintain a sufficiently strong nutritive solution to meet the needs of rapid growth. But with such large amounts of the essential plant food elements present in the root zone of most agricultural soils; and with so much as we have shown to be present, even in the poorer soils, which may be readily removed with water, it may appear strange, at first thought, that reduced yields can result from a deficiency of plant food materials. Observations, however, have shown that the plant sap during vigorous growth is, and apparently must of necessity be, strong in all of the plant food elements. But in order that this may be so maintained, we have reason to think that the soil solution outside of and in contact with the absorbing roots must be maintained correspondingly strong. Certain it is that if we place salt meat in pure water it becomes less salt; and if we wish to render it more salt we must place it in a brine more concentrated than that present in the meat, and we believe that the same relations hold for plants, although sufficient proof is not at hand and a different view is held by many. If the view here expressed is correct, any highly productive soil must be rich in the readily water-soluble plant food elements and it must carry through the growing season much more of these than will be required to produce the crop upon the ground, or else it must possess the conditions which permit the soluble food materials to develop faster than they are needed. It need not seem strange, therefore, that soils increase in productive power with the addition of manures and fertilizers even where it may be shown there is present in the soil at the time and in readily soluble form more than the crop can remove. If the physical condition of a given soil—its openness, its extent of internal surface and its crumb-structure—is such that it must carry in soluble form more than can be removed by a dozen crops in order to be able to supply the plant food elements as rapidly as the one crop can use them, then such a soil must decrease in productive power whenever any one of the esential food elements cannot be delivered to the crop as rapidly as needed even though there be present in the soil enough for a thousand crops.

SOURCE OF THE SOLUBLE PLANT FOOD ELEMENTS.

The water-dissolved plant food elements, which are the direct source of the plant food derived from the soil, come from two ultimate sources, (1) the mineral portion of the dry soil itself, and (2) nitrogen from the soil-air fixed by micro-organisms. But, indirectly, the immediate sources of the plant food elements carried in the soil moisture are the slow solution of the soil grains themselves and the decay of organic matter which overspreads and comes in contact with their more or less extended surface. The amount of internal superficial area given to the root zone of a field by the aggregate surfaces of the soil grains is a very important factor of productive capacity. This is so because it is over this surface the soil moisture is spread to become charged with the essential plant food elements derived from the soil grains themselves and from the decay of organic matter disseminated among them. It is upon this surface that the soil organisms live which hasten the decay of the organic matter and so charge the soil moisture with plant food materials; and it is against the same surface that the root hairs of crops place themselves to appropriate both the moisture and what it has dissolved. The internal soil surface of every field is, therefore, a pasture where plant food grows and upon which crops, through their roots, feed.

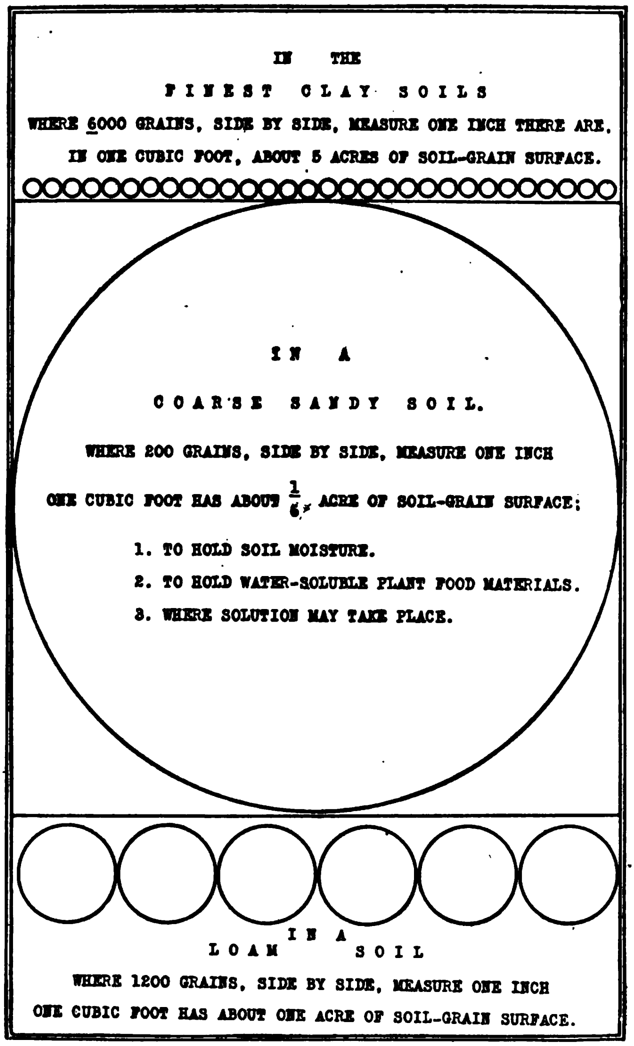

IN THE
FINEST CLAY SOILS
WHERE 6000 GRAINS, SIDE BY SIDE, MEASURE ONE INCH THERE ARE,
IN ONE CUBIC FOOT, ABOUT 5 ACRES OF SOIL-GRAIN SURFACE.
IN A
COARSE SANDY SOIL.
WHERE 200 GRAINS, SIDE BY SIDE, MEASURE ONE INCH
ONE CUBIC FOOT HAS ABOUT 1/6 ACRE OF SOIL-GRAIN SURFACE;
1. TO HOLD SOIL MOISTURE.
2. TO HOLD WATER-SOLUBLE PLANT FOOD MATERIALS.
3. WHERE SOLUTION MAY TAKE PLACE.
IN A
LOAM SOIL
WHERE 1200 GRAINS, SIDE BY SIDE, MEASURE ONE INCH
ONE CUBIC FOOT HAS ABOUT ONE ACRE OF SOIL-GRAIN SURFACE.

Fig. 2.—Showing by circles the relative diameters of the grains of coarse sandy soil; finest clay soil and loam soil, 636 times average diameter.

The extent of this internal surface is very great and very different in the different soil types. Let me try to help you to better realize this very fundamental and important truth. Imagine a cube of granite one square foot on each face. If this cube were lowered into water and raised from it again it would come out overspread with a sheet of water measuring 6 square feet in area, for the cube has 6 faces. Let this surface be dusted over with finely ground stable manure, well charged with the soil organisms which bring about its decay. A spear of corn planted at the center of the top face of this cube would find itself in possession of a pasture area measuring six square feet, over which its roots could place themselves to imbibe moisture and the food materials with which it becomes charged as solution of rock and decay of organic matter takes place. Now imagine the cube quartered. The area of the surface of granite, of the sheet of water, of the pasture, is doubled, for there are now 4 cubes each with an area of 3 square feet and with no more soil, the corn roots have a pasture of 12 square feet. There are 12 square feet upon which solution may take place, to which water may adhere, where organic matter may decay where the roots may feed. If now each of these cubes is quartered, their surfaces will again be doubled, and we shall have a cubic foot of soil, whose aggregate surface measures 24 square feet. Make the cubes one-hundredth of a foot on an edge, and the total surface becomes 600 square feet. If again the cubic foot of granite is divided into cubes one thousand of which together measure an inch, the separate pieces may be readily seen singly with the unaided eye, and it would be so coarse that we would call it a fine sand, and yet the total surface to which water could adhere, upon which chemical action and solution could take place, and against which the root hairs could place themselves to feed, would be 6,000 square feet, or one-seventh of an acre per cubic foot.

On this chart there has been represented, all on the same scale, circles having the effective diameters of three soils, the finest clay, the average loam and the coarse sandy type. In the finest clay type it requires 6,000 of them set in line and in contact to measure an inch; in the loam type, 1,200; and in the coarse sandy soil, 200. Of the particles of the finest clay soil 30 are required to span the diameter of a single grain of the coarse sandy type, and five of them are needed to measure one of the mellow loamy soils. From our illustration of the cube of granite you will readily see that the finest clay soils possess 30 times the internal surface, to which water may adhere, upon which soluble and dissolved plant food materials may be formed and stored, and where soil organisms and the roots of plants may feed, that which is possessed by soils of the coarse sandy types, and five times that possessed by the loams.

So great is the internal surface of soils that its extent must be expressed in acres per cubic foot, and in the three cases chosen for illustration, the coarse sandy soil possesses no less than one-sixth the loam, 1, and the finest clay soil more than 5 acres of soil-grain surface for each and every cubic foot of such soil in the field. These areas aggregate for the surface foot and per acre of field more than 10, 60 and 300 square miles, respectively, for the coarse sandy soil, the loam and the finest clay type. Twelve hundred, two hundred and forty and forty square miles of pasturage in the four feet in depth of the root zone surface, per acre of crop, seems like an enormously extravagant allowance upon which to grow grass and grain and vegetables and fruit, and yet it is what nature has provided. Verily, every farmer is a multi-millionaire in the acres of internal soil surface from which he wins his harvest! And now I must repeat once again that it is over such vast areas as these that the soil moisture of the effective root zone is spread, from which it dissolves the mineral ingredients it carries and against which both these and that which comes from the decay of the organic matter is stored for the use of crops.

With these conceptions of the differences between soils of different types and of the manner in which the soluble conditions of the plant food elements accumulate so as to be appropriated by crops, the great importance of a deep and abundant incorporation of organic matter in the soil can be appreciated; because through it decay takes place in contact with a much larger soil surface, more room is given for the soil organisms to work, the plant food materials produced may be concentrated upon and retained by a much larger surface, and there is greater opportunity for the roots to come in contact with the plant food developed and stored.

Deep incorporation of organic matter is accomplished by a thorough turning under of the roughage of the fields, using the jointer and chain where necessary; through frequent moderate and occasional deep turning down of both stable and green manures; by growing in rotation the deep-rooted leguminous species, together with the densely and deep-rooted grasses. No form of organic matter for incorporation in the soil is so valuable as stable manure. It is so because it has been placed in superlative physical condition by being finely ground and because it is doubly charged with the most available of plant food materials. The great problem is to get it incorporated with the soil deeply and thoroughly while it is yet at its full strength. To throw it about to weather in the rains and the sun is no less irrational and but little less wasteful than would be a similar practice with the hay and the grain from which it was produced. Excessive applications to the soil, too, like the overfeeding of live stock, is literally throwing money away, besides making some effort to do so. Next to the waste of fertility, which occurs before getting manure to the field, is that of applying it unevenly and over too small an area. Moderate applications, well spread and well incorporated with the soil, are far better than heavy dressings applied at long intervals. The danger is, where heavy dressings are applied, that the fermentation will be carried too far and a very large part of the nitrogen be lost in the form of the free gas. Maximum amounts of stable manure are seldom made on any farm. All the roughage and

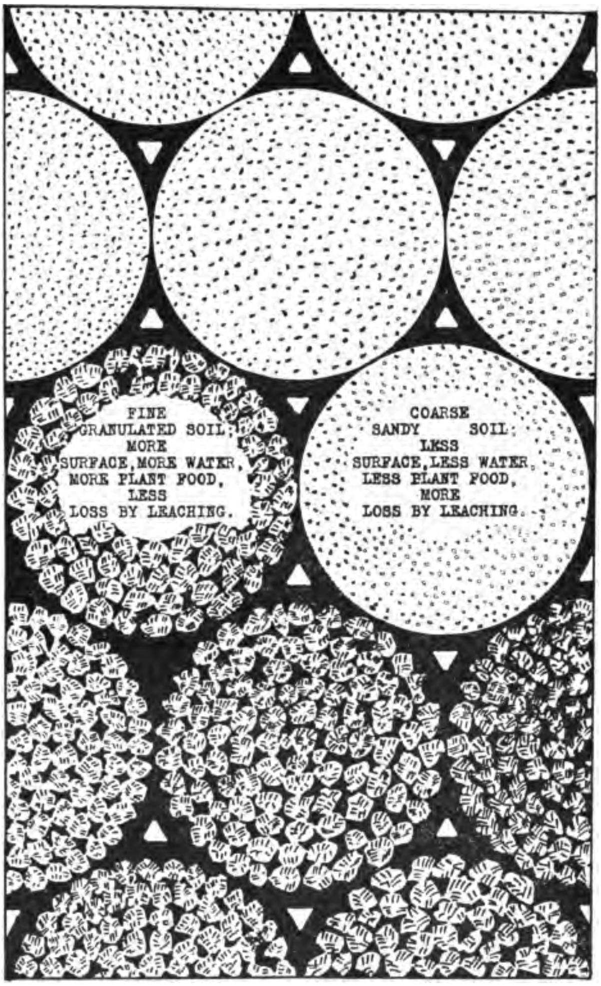


Fig. 3.—Showing the grains of a fine clay loam soil grouped together in the form of granules equal in size to the average grain in a coarse sandy soil. The dotted circles represent single solid sandy soil grains, the solid black represents the films of water surrounding the soil grains and soil granules and filling the spaces between the grains making up the granules of the clay loam soil.

waste of the fields would be much more efficient as a fertilizer if it could be first used as an absorbent, and to be most efficient when used in this way it should be cut fine. Stable manure is but finely ground roughage, saturated with the best kinds of plant food materials, but stock may be made to sufficiently saturate two or three times the amount they will eat, and thus increase the fertilizer product of the farm at least two-fold. Nothing can increase the yield of the corn belt so much as to shred or cut finely the stover, now wasted on so many fields, and make it into manure by using it as feed or as an absorbent and then effectively applying it to the fields.

GOOD TILTH.

Good tilth, or a thorough, deep and strong granulation, giving a well marked crumb-structure, is the most important physical condition of any soil. The great urgency of the crumb-structure in soil grows out of the fact that in all but the coarsest sandy soils the individual grains are so small that when they are not bunched together the capillary pores are so minute as to make them like the potter's puddled clay, nearly impervious to both air and water. But when the fine soil particles are collected and more or less cemented into larger compound grains, much as pop corn is made into balls, then there is opportunity for the roots and the root hairs to advance between them, placing themselves so as to absorb the moisture and plant food materials which surround and are contained within. Upon the surfaces of these compound grains the microscopic soil organisms place themselves where their products of decomposition have the best opportunity to act as a solvent upon the soil and also where the products may easily diffuse into and be retained by the granules against loss by leaching.

When a soil is well and strongly granulated each compound grain becomes like a tiny sponge, which may maintain itself full of water highly charged with plant food materials, to be sucked out by the root hairs when they develop alongside of them; and hence, a strongly granulated soil has a greater capacity for both available soil moisture and for plant food. It will be clear that where the soil is strongly granulated, so that the larger particles have a sponge-like openness, these will hold within themselves and away from their immediate surfaces large amounts of plant food which cannot be so readily leached out, for then the rains drop down rapidly through the larger passageways without strongly affecting the solution that is within the granules themselves. Besides, where this structure exists and the action of the roots has partly dried the granules out and at the same time removed a portion of the plant food which they had stored, then when a rain does come which causes the water to move downward, whether by capillarity or by percolation, these partly emptied granules will draw the water with the plant food which it may carry back into themselves and thus hold both the moisture and the other nourishing elements up nearer to the surface where they will be more efficient. And so it is that a strongly granulated soil may profitably be more highly fertilized than one which is not and so maintained at a higher stage of productive power. To illustrate, when a solution carrying potash was allowed to percolate very rapidly through the four poor and the four good soils, to which reference has already been made, the soils which were most highly granulated and which possessed the highest productive capacity were able to absorb from the solution and retain within their granules at the rate of 1,736 pounds of potash per acre of the surface foot, while the four poor soils, less strongly granulated and possessing less internal surface, were able to take from the solution at the rate of only 893 pounds per acre.

In proof of the greater power of highly granulated soils to hold-back against leaching the plant food elements, the same 8 soils were treated with the same amounts of the same kinds of stable manure, and then, after an interval of six months, they were all leached in the same manner and with the same amounts of pure water, to see how much of the plant food elements would be retained. The results obtained are given in the next table.

Amounts of manure applied	25	50	100	200 tons per acre.
Potash in manure	109	218	436	870 pounds per acre.
Potash retained—				
Four good soils	91	182	384	663 pounds per acre.
Four poor soils	77	160	276	448 pounds per acre.

The table shows how different was the power of the two groups of soil to hold back against leaching the potash which had been carried to them in the stable manure. It will be clear also that when the roots of crops spread themselves out over these differently charged soil granules, which are filled with and surrounded by moisture carrying the plant food, they are under the very best conditions to obtain and utilize it.

In order that there may be established a strong and deep granulation of the soil, the first essential condition is ample under drainage, and it is most fortunate that, in the great majority of fields, natural conditions abundantly secure this. The most universal condition, requiring attention on all soils, except in the very limited highly organic types, is a deep and abundant incorporation of organic matter in the soil. When the organic matter is deeply and abundantly distributed throughout the root zone, it acts as parting planes between the soil particles which prevent them from running together during times when the soil is long over-saturated with water. At the same time, when shrinkage comes in times of drought, the finely divided and well distributed organic matter greatly favors the action of the surface films of water in drawing the small particles of soil together into bunches. One of the most important advantages of growing the grasses like bluegrass, timothy and redtop in the rotation, is that, through their immense number of roots closely threaded in among the soil particles, they greatly facilitate the bunching of the soil particles together. Such crops are much more helpful in this way than are the clovers, whose great service lies in their power to increase the nitrogen content of the soil. The two types together, or in alteration, give the best and most enduring effects.

Winter weathering, naked summer following, fall plowing and liming are other treatments which greatly influence soil structure.

SESSION

Missouri Improved Live Stock Breeders' Association.

Thursday and Friday, January 11 and 12, 1906.

PRACTICAL AND TIMELY HINTS TO BREEDERS.

(T. J. Wornall, President Missouri Improved Live Stock Breeders' Association.)

(On account of sickness in his family, Mr. Wornall was unable to be present at this meeting and deliver his annual address. We print the following article in lieu thereof.)

There are so many places that need fixing that keep us from having a perfect system, I will only speak of the most important, dividing them into two general classes—"Needed Home Improvements" and "Needed Foreign Improvements"—meaning by the former those improvements that lie within the reach of every man interested in the breeding of pure-bred cattle to make. The latter, those improvements that can only come by help of others, but in the accomplishment of which we all enjoy the same blessings.

And for the better handling of my subject I will subdivide the "Needed Home Improvements" into five classes, as follows:

First—The tattooing in the ears of the calves numbers so as to distinguish them, and the placing of those numbers in a conspicuous place in the records properly kept. This should be done at the first opportunity. Then, when those animals have attained the age of 2 years, the identical numbers should be branded on their horns, where they will remain indefinitely. All animals purchased—either publicly or privately—of that age, should be branded with your number the day she is received into the herd. If she is already branded, an additional number could be placed lengthwise in front of that already on, which will serve the purpose in showing at a glance she is not of your own breeding, even if her individuality does not show itself.

When the animal from the herd is sold or transferred to that of another, with the tattoo marks or horn number both on the certified copy of the pedigree and the animal, it is but another safeguard thrown around our business.

IMPORTANCE OF KEEPING RECORDS.

Second—Better kept records. On this subdivision of "Needed Home Improvements" too much cannot be rightly said, since it is a matter of such vital importance to the industry. And representing as it does the heart and vitals of it, we cannot be too careful of the records. The certified pedigrees should be furnished by the seller and is, of course, accepted as final. It should be carefully copied into your own record and the number given the animal placed opposite the name and branded on the horn. But if the animal is purchased without a certified pedigree and the seller refuses to furnish it, the purchaser should send to the association, inclosing 25 cents, and get one. And in so doing, I will venture the assertion that you will find an error in at least one in five, and sometimes as many as four in ten. And this does not result in any dishonest motives, either. For the changes are not frequently of such importance as to materially change the value of the animal, but are more the result of carelessness on the part of compilers and printers. Nevertheless, if you are to keep your records, you should have them straight to begin with.

Then the produce columns should be as carefully kept as the calves placed there on the date of their birth. Their tattoo numbers put on record and their sales, or death, noted the same way. By the careful use of these two things a man can lose a herdsman, or even die, and know that his heirs or adminstrators can take up his business and carry it on or close it at will.

And in addition to this I would keep a book, just as your merchant does in his business. I would enter the name and number of the animal, date of purchase, whom bought of, price paid, freight and expense. Then I would charge her with so much a year for keep and give her credit for every calf, either sold or retained, in the herd. And in that way you can know at any time just what she is doing for you, or doing you for. If not profitable, you will know what to do more quickly than by the old guessing system so much in vogue.

LIBERAL AND JUDICIOUS FEEDING.

In the third subdivision I would advocate the more liberal and judicious use of feed. After you have carefully selected your matrons for the foundation of your herd, and still more carefully selected your sire, you will cross on. You should be next thinking of what kind of feed to cross the calf on.

And on the improvement we make by breeding we can only carry out by feeding. We have all received the letters of inquiry that contained the warning injunction before closing—"I don't want a pampered calf." And we have all had the same fellow come, and sold him the only fat one we had. But we have not all learned the lesson that we should in doing that. We may have spasmodically neglected to start the others sooner.

As an illustration of that I can recall a prospective buyer who, at my directions, within the last year, visited nine herds of Shorthorn cattle and only bought thirty-two bulls; whereas, in four herds of another breed he purchased sixty-eight, when his order was for sixty Shorthorns and forty of another breed. He claimed they were not in any sale condition. I may be wrong in this statement I am about to make, but it is the result of my observations in the Shorthorn business: That there is no need to select the seed from which to breed without you feed.

HARM DONE BY UNDERFEEDING.

And I am of the opinion that there has been many times more harm resulted from underfeeding than from overfeeding. While the loss would appear to possibly not probably one in twenty-five from the latter, we suffer a loss from twenty out of twenty-five in the former.

How does a buyer know an animal will ever get in good condition if you don't have him that way?

Fourth—I would advocate the use of the knife more in raising the standard of both bull and the steer market. There are two classes of bulls it will pay to cut. The best you have that will make a show steer (which, if a winner, will make you famous), and the worse you have to keep from making you infamous. The former will bring you $1,000 in prize money if a winner at Chicago. The latter will cost you $1,000 if seen at some places.

THE DIVISION OF PASTURES.

Fifth—I would like to see improvement in division of pastures, where many herds are kept. In many of our good herds of cattle all ages are allowed to run together. If a merchant, in displaying his wares, was as careless as we he would not sell as much. As far as practicable run the aged cows in one, the 2-year-old heifers in another, and so on.

They always present a better appearance and much uniformity can be accomplished without much expense. And more especially would I advocate that in selling bulls.

One car load will bring enough more to pay for the cross-fencing. There are many more things to be thought of in that same line of needed home improvements, but rather than get wearisome, will touch on the second classification under the head of "Needed Foreign Improvements."

Like the other, we will subdivide into classes. The first from which benefit might be had would be in the visiting other so-called better herds. I can speak with confidence along this line, for it has been my pleasure and profit to have visited at some time or another nearly all of the large herds of this country and in the old, as well. I never visited any that I did not learn something not to do, frequently both. And I wonder that more of it is not done.

GOOD THING TO BE SOCIABLE.

It is not from lack of sociability, I know, for the Shorthorn cattlemen are a set of princely entertainers and have that feeling for each other that no other breed can touch. They are pointed out and referred to in every gathering, so it cannot be from that. They are not too poor nor too stingy, for a man with a good herd of Shorthorn cattle, on a good farm, has a kingdom unto himself. So it must be he is too busy. But is he right in thinking so? Can he not find time to visit, say, one good herd each year, and, by the comparison with his own methods, gain twice what he would otherwise?

The general idea of cattle breeding has been well hashed over, but the detailed thought required in successful breeding presents a world unconquered.

How many are they who talk so wisely about the outcross in a seemly straight pedigree, that can tell anything of the individuality of the granddam or grandsire of the animal mentioned? Yet might have seen both, for they were likely raised within easy riding distance.

THE QUESTION OF SHIPPING.

Second in importance is the question of shipping. Railroad rates should be lower to encourage the breeding of good stock on shipments of pure-bred animals, where pedigree is shown in evidence. Outside of J. J. Hill of the Great Northern, however, no one of the railroads seem inclined to give it. But there is one arbitrary rule in vogue among the railroads that is sadly in need of correction. That is compelling you to send a man in charge of animal and forcing him to buy a ticket full fare both ways, and a resolution to that effect should be passed at this meeting. It is unjust, unreasonable and unfair in every way.

USES AND ABUSES OF PUBLIC SALE.

The third thing I would call attention to is the public sale; its uses and abuses.

The public sale is the market marker, as the rule we are all supposed to go by, and is somewhat a criterion for guide. But the sentiment for the place for holding it has changed materially. It used to be the people would not attend if it was not held at some centrally located place, easy of access, and we were forced to go, in some instances, quite a distance with the cattle. But now the demand is that you shall hold it at home and the needed improvement in that line is here. For by doing that you can show and be shown the breeding herd and your methods come to the surface, to the best interest of both buyer and seller. And it has practically done away with that "nuisance of nuisances," the "sale pirate," for while he might, and did in some instances, go to your city or town sale and solicit your buyers to go home with him, he has scarcely gall enough to come on your farm and do so.

POINTERS ON CAREFUL ADVERTISING.

Another improvement that carries with it intelligence in business is careful advertising. We will advertise, of course, one or two ways. We advertise in the papers and advertise at home, and we should be very careful that the advertisement in the newspapers corresponds with what you are talking about at home. For it is hard enough to get your buyers to your place once. And if they do not find your statement materially correct, you can be assured they will not return. Another thing is a system of checking our inquiries. How many of us really know what paper, or papers, have done us the most good. It is confusing to ask the field men, for they are hardly a unit on the proposition. And while I'm not a sponsor nor agent for anyone, there is a system that simplifies the matter for you.

Another improvement is to quit advertising job lots. Great clearance sales and great fire sales are expected from Hebrew merchants, but unless you are badly burned do not sacrifice your goods.

ALFALFA.

(Joseph E. Wing, Mechanicsburg, Ohio.)

My interest in alfalfa first began when I was a boy in 1886. I remember traveling on the train out in Utah, going on a visit to my uncle, and looking out of the window I saw stacks of hay just as green as if they had been painted with green paint. I remember calling to the conductor on the train and asking him what it was. "Why," he says, "that is alfalfa." I asked him what made it look so green. "That's the color of it," he replied. Well, when we got to Salt Lake City we went out early the next morning and stumbled on to the hay market. There were great loads of alfalfa standing there just as green as could be. I went up to them and chewed up some of the hay to see what it tasted like. That's my test to see if the cattle and sheep will like a thing or not; it's a good test—don't be afraid to try it. Well, that alfalfa I ate tasted good and I said, "Joe Wing, you have struck the best country in the world. If you ever get hard up, just go out to those hay stacks and help yourself." I remember my uncle had a big milk cow which he fed on alfalfa; she was extremely wide out and able to eat a whole barrel of alfalfa and drink a tub of water at one time, and the amount of milk she gave was wonderful. And it was from that old cow that I gained my first impressions of the value of alfalfa as a feed and there that I learned to grow it. We fed alfalfa to our hogs and finished them off with a few nubbins of corn; we fed it to our horses. Bought some of the seed and sent it home to father—about a pound I guess. After I had been out there for two years I went home, and after I had seen father and mother, I wanted to know where that alfalfa was. "Why," father said, "its back here but it is not worth going to see." "It did not do any good here; it may be a great thing out west, but red clover is the thing for our country." Well, he took me back there where the alfalfa had been sown and it looked pretty shabby to me when I first saw it; was not more than three of four inches high and there were hardly any leaves on it. I stood there looking at it for a long time, and while I was looking at it I saw my mother's chickens come along and pick off each leaf. An idea came to me and I went and got a tub full of water. My father said, "What are you going to do?" I told him I was going to show him how they irrigated in Utah. I poured this water slowly on one plant; I jerked the top off of a barrel and set it on the alfalfa plant and went away and forgot all about it, and when I came back to look at it the stuff had grown almost through that barrel. I called my father to look at it and he was very much surprised, but he said, "My boy, do you suppose I want to grow a crop that won't grow unless I put a barrel over it?" Well, that was a very small beginning. I used to lay awake nights thinking of the old farm where I had been raised. I loved the old place passionately. I thought if ever I got back there I would make alfalfa meadows grow there; for if I could make one acre grow like that one plant that I saw last year, I could make a million acres grow if conditions are right. So when I came home to stay I brought some alfalfa seed home with me and tried to get father to let me sow it. Finally he said, "You can have that old potato patch if you want it," and so I sowed, in 1890, my first alfalfa in Ohio. I sowed it in the old potato patch. It was good land—clay soil, well manured, and it grew finely. Next I sowed three acres more, but the alfalfa did not do any good—only got one acre out of three to grow; one acre was wet land and one was poor. I saw that I would have to drain the land, so I started in. We laid, between then and now, fourteen miles of tile underdraining and we hauled a lot of manure. Little by little we got our land into alfalfa—it could not be done all at once. We own farming land now worth to us $150 an acre; it makes big interest on that all the time. It is wonderful what you can do if you just get in partnership with the Almighty. We took up this work of raising sheep in order to get manure to make the fields rich, and little by little we learned to grow alfalfa to feed the sheep.

I will tell you how we bring up land to grow alfalfa. We bought sixty acres a few years ago. The physical condition of the soil was all wrong; there was little fertility in it. First we put some tile-undrains in it—that was adding so much more money to our investment. Then we took our manure spreader and spread manure on the land and also put on some commercial fertilizers, and we got a fair crop of corn. Then we planted it to oats with red clover and put some alfalfa seed in with the clover. We got a pretty fair stand of clover. Then we planted it to corn again and got a good crop. Then we sowed it to clover and alfalfa again and got a much better stand. It will go to corn again this year, and the men were spreading manure all over that field when I left home. Next it all goes to alfalfa. Oh, manure is a great thing. I love to see great loads of it go by. It helps the soil to get pervious. Alfalfa will surely grow on manured land.

Now, what are the advantages of alfalfa any way? In the first place, alfalfa is a perrenial plant, living from year to year. In our country alfalfa meadows endure from six to ten years. Then, alfalfa is so deep-roote; as deep as you have any soil alfalfa roots will go down. If the soil is two feet deep, the alfalfa roots will go down two feet; if ten feet and even twenty feet, the alfalfa roots will go to the bottom and even farther than that. And another thing: alfalfa comes up so early in the spring. Soon after you have your corn planted, you have an alfalfa crop to cut. It is green the first of the season when nothing else is out at all. The time to cut it is when the leaves are beginning to to drop off. After it is cut, in only fifteen minutes, up it comes again, and in 30 days you have your second crop ready to cut. We always get four crops in our country. Of course some of the crops may be light if you don't have enough rain, but you will have them anyway, and you have to take off the light crops or it will not do its best—you will miss the subsequent crop. Your third crop may not be very heavy, but cut it off just the same and you may get a fourth cutting that will be good.

We average four tons an acre and sometimes get five or six. Up at Ames, Iowa, they tell me they got seven tons; that's a pretty good yield. Now, about the use of alfalfa when you get it. It is fine for dairy cows. Down in Eastern Pennsylvania, where the dairymen are trying to do big things, we are sending them alfalfa hay for their cows, and they tell me great stories about it. One man down there who has registered cattle and is trying to make them give all the milk possible by feeding them the best he knows how, said to me, "Mr. Wing, since I have fed your alfalfa hay to my cows they give 20 per cent more milk." Isn't that marvelous? Now alfalfa hay is the best feed for working horses and the best for colts. It is the very best thing for all the four-footed babies on the farm. It is so full of protein, it dissolves and goes into muscle and goes to make milk and builds up the animal. Out in California the best thoroughbreds are fed on alfalfa hay; they eat it in the meadows summer and winter. When I first saw those California thoroughbreds I did not know what they were. They are so fine and well developed.

Now, of course, it has a drawback. You are taking food from the soil all the time and leaving the soil poor. You have been told here that you could take off only 1,000 crops and you have your soil worn out. But you know some soils will wear out quicker than that. You remember the piece of land I told you about last night that I bought—the clay soil which I enriched with manure and put into corn in '85. Then in '86 I sowed it to alfalfa. I remember that year well, because it rained so much—32 days every month, but I got a good stand of alfalfa. Then during '87, '88, '89, and for five or six years, I cut four hay crops every year. Took off all that hay and put nothing back.

Just think how we drained it of richness. Mother used to say, "you are wearing that soil out." Well, when I planted that land to corn again we got 80 bushels. Just see how it had worn off that land. Now how did we do that? It sounds like a miracle or a lie, one or the other. I will tell you, as near as I know. Away down in that soil, just as far as you can drain the ground out, those alfalfa roots will go—yes, just as deep. Now what do they do down there? They are lying up close to the minerals of the soil, bringing up the potash and phosphoric acid nearer the surface, and on every root fibre are little nodules full of bacteria, and the air coming down full of nitrogen, the bacteria swallow the nitrogen and give it out to the alfalfa plant. It is really true that an acre of alfalfa will produce you as much fertility in a year that would cost you $60 if you bought it in the bag. That's the way we build up our farm—not by fertilizers alone—but by alfalfa roots and manure.

I was down in Kentucky one time, and, as I always do, I was looking for alfalfa fields. I was walking around one day and looking up I saw an old Kentucky farm up on a hill. I thought it ought never to have been cleared for a farm—the fields looked so steep, so bare and pitiful, and there was an old barn and an old dilapidated house. There were still a few old apple trees. A picture came up in my mind of the time when that farm was first cleared—of the young man who brought his wife there and raised boys and had hopes that those boys would stay on the old farm. But where were those boys now? They have probably gone to the city and left the old farm. Then I could imagine the old man up there with his worn face, amid these poverty-stricken surroundings, wondering what he was going to do, and while I was feeling this pity for the old man, I looked up and saw an alfalfa field—only two acres of it, but just green and growing in the sunshine, and I said, "why, see that alfalfa. That old man has caught hold at last. If he will treat that alfalfa right, it will make him manure for starting another patch, and some day, if he keeps on, he can spread the glorious banner of alfalfa over that whole mountain side; and then his boys will have to stay at home and care for it, and that old hill side will never get any poorer than it is now, but richer every day."

Let me tell you more about that old farm of ours. When I began working on it an old lame darky did most all the work. Today I have three married men there at work besides my two brothers; and those three married men work there for $1.25 a day the year around. I pay them that the year around. They have been with me for many years; they think they own the farm. Their little boys go to school along with my little boys, dressed just as well. And on that old farm there are several single men working part of the year. Think what that means. We have increased the producing capacity many, many fold since taking hold of that old farm and putting alfalfa on it.

I have been asked a hundred times since at this meeting whether you can grow alfalfa in Missouri. Why, of course, you can. There is not a man here who cannot grow alfalfa on his farm. It wants a soil that is fairly dry; not necessarily dry every day in the year, but one that is not water-logged for a long time during any part of the year. You must have that. I am not going to tell you how to get it dry. I tile-underdrain mine. You should manure the ground thoroughly. And you must have the land sweet. Now, on our soils we have not found it necessary to use lime; but on many soils, especially in New York and in Northern Ohio and Pennsylvania, they find it necessary to lime the soil to make it sweet. Now if it is sweet and dry, there is only one more thing necessary to make the alfalfa grow, and that is to get plenty of humus in that soil, plenty of vegetable matter. This humus decaying in the soil makes plant food. You must have the soil rich before the alfalfa will start at all. But, more important than that: the humus in the soil makes a home for the bacteria and they will not grow very well without it. In all the region this side of the Mississippi river, you cannot usually get the inoculation to take place without manure. That's the experience in Iowa. Now, those are the three things necessary to make the alfalfa grow: the soil must be dry, it must be sweet, and it must have plenty of humus.

DISCUSSION.

Governor Colman: The subject of alfalfa is one of so much importance to the farmers of Missouri that I cannot refrain from saying a word or two in regard to the importance of cultivating this crop. I have had some ten years experience in raising this crop, and I consider it by far the most profitable crop I produce upon my farm. I raise it chiefly for horses. I have a large farm devoted to the production of horses and keep about 100 head. For ten years I have tried this crop. I had some difficulty in getting the first crop established. My farm produces immense crops of crab grass and foxtail which nearly smother the alfalfa out the first two years, and the only way to prevent that is to run the mowing machine over it frequently. I have about twenty acres of it; I sow it in the spring. My neighbors, who suffer from crab grass as I do, sow it in the fall, or about the last of August, and have very successful crops. My farm is situated on the Creve Coeur lake, and that lake was once the channel of the Mississippi; but the river got choked up and turned off at St. Charles and it is what is termed the loess formation. And here I find the alfalfa crop a profitable one. I cut about five crops each year and 8 or 10 tons to the acre. This year, being short of help and not cutting as often as I should, I only got four crops. I like it better than clover because it is not so much injured by rain. Generally when you cut red clover you have a good deal of rain; rain comes at that season of the year, and I have had a great deal of red clover spoiled by rain, but have never had any alfalfa injured by the rain—that is, materially injured. Alfalfa is the best crop that can be grown for the feeding of young colts and mares; and they eat it with greater avidity even than they eat red clover. I am compelled to stack some of my clover and some of my alfalfa and also some oats, and I have one lot in which I stack these different things and I sometimes turn my colts into the lot where these stacks are; and if you should visit that lot, you will find the stacks of alfalfa almost ready to fall down because the colts will go and take it in preference to the red clover and the oats or any other crop that can be raised; so if you want to please the appetite of your stock, feed them alfalfa; it is the most desirable feed that you can give to your cattle, your horses, your sheep or your swine.

I know that many farmers have a good deal of difficulty in getting the crop established. Now my fields have been established for at least fifteen years, and I am almost ashamed to say that I have not put one single pound of manure upon my alfalfa fields; but I am very careful to save all of my manure, and I have a manure spreader which I use in carrying out all my manure; but I put the manure on my corn land instead of my alfalfa land. I use phosphate rock on my corn land, and I find that where I use it my ears of corn are heavier and better than on the land where I did not use the phosphate; and I think that phosphate is an important fertilizer which our farmers should purchase and apply to their lands. I do not want to see our lands wearing out. I want to see returned to the soil that which has been taken from it. The bane of our farming in Missouri and the bane of the farming in the older states of the Union has been in exhausting the land of its fertility, taking crop after crop until it will no longer produce them, and the lands are turned out as waste property and abandoned farms as is the case in Virginia, Maryland and the New England states; and we must institute a different system here. I find alfalfa to be equal in fertilizing qualities to red clover. Now, I don't want to be understood as going back on red clover. I think it is the farmer's salvation; but I believe that every farmer can raise alfalfa. I should be glad to see a patch of alfalfa on every farm. Would not start it on a large scale at first—but would experiment with it a little. If your farm produces crab grass in abundance, I would say by all means prepare a field for your alfalfa. And to most of you I would say plant it in August so to avoid the crab grass and foxtail. I have seen it tried in the spring again and again without success. In the Missouri river bottoms, during that terrible year of drought, it was a pleasure to pass by those green fields of alfalfa. The drought did not affect the alfalfa at all. So I would say to you gentlemen, if you want to raise hay in any form, go to work and study up on this alfalfa question. Be sure and get good seed; prepare your ground thoroughly and sow your seed about the last of August, and I believe that none of you will regret having done it.

Dr. Waters: I dare say there is no point about which we have so many theories as alfalfa; and about the only way for you to learn how to grow alfalfa is to grow it. Start it on a small scale, of course, but grow it. It is being grown successfully in nearly every county in Missouri in a small way. You cannot hope to succeed as well from the outset as did Governor Colman; but by following some suggestions which Mr. Wing has given you, and particularly avoiding sowing in the spring, and by preparing the ground thoroughly, you should be able to get a good crop. I would not plant alfalfa seed later than September 1st.

Mr. ————: Do you think rain will hurt the alfalfa? We had a heavy rain this fall when I sowed my alfalfa seed. Do you think I should sow it again next spring?

Governor Colman: No, I would never sow it in the spring; sow in July or August.

Mr. ————: Do you use a blue-grass seeder?

Governor Colman: It does not matter. A grass seeder attached to a grain drill is what I use.

THE DRESSED BEEF DEMONSTRATION.

(E. B. Forbes, Assistant Professor Animal Husbandry.)

The people of the United States spend annually about $1,526,000,000.00 for meat, and as an average result of a large number of dietary studies conducted by our government, we determine that this represents 37.2 per cent of our entire expenditure for food. In the light of these facts, it is astonishing that we know so little about meat, and it is with the object in view of making a general contribution to our knowledge of this important subject that we have planned the work of this demonstration.

The lean portion of beef is composed of cylindrical fibers about 1-500 of an inch in diameter, and from 1-50 of an inch to 2 inches in length. Each of these fibers is composed of a cell wall of connective tissue or sarcolemma enclosing the muscle plasma. This last is the contracting substance of the muscle. These microscopic fibers are bound together by enveloping sheaths of connective tissue, and these bundles are again bound together into larger ones, so that the whole body of the muscle is made up of a contracting muscle plasma and enveloping connective tissue.

The two prime considerations in the selection of beef are tenderness and flavor. Toughness in meat is caused principally by the thickness of the sarcolemma or other connective tissue. Age and exercise thicken this substance and hence toughen the meat. Acid softens or gelatinizes this portion of the muscle and hence renders the meat tender. Cooking increases the acidity of meat, and this acid and the heat used, change its connective tissue into gelatine.

The fineness of the grain of meat is also an indication of the amount of connective tissue present. Coarse grained meat is usually tough. As good a way as I know to test the tenderness of a steak is to take it between the thumb and forefinger and note the resistance which it offers to firm pressure. One may pinch a hole in a tender steak in this way very easy indeed.

The color of meat is also to some extent of value as an indication of tenderness. Dark meat is dark because of the amount of blood contained in it. The more exercise the animal has had the tougher will be his meat, the more blood will be in his muscles and the darker will be the color of the lean. We see an instance of this fact in comparing the meat of a fat young beef animal with that of a dairy cow. The lean of the former will be a bright cherry red; and the lean meat of the latter will be a very dark, bluish red, and is most undesirable.

The color of the fat of meat is also useful as an indication of the quality of beef. Fat that has been put on rapidly, as in successful fattening, is light in color, and the whiter the color the better we like it Shorthorn and Hereford cattle have very white fat if quickly fattened. The fat of Angus cattle is slightly darker, but is still of excellent quality. The fat of Jersey cattle, especially old ones, or those which have been fattened slowly, is very dark and of a saffron yellow hue.

The flavor of meat is due very largely to nitrogenous compounds which are easily extracted with water and which the chemist therefore calls extractives. The per cent of extractives present is increased by age and by exercise, just as is also the toughness of meat; hence we find that the toughest meat is the best for soup, for it has the highest flavor, and if successfully cooked is really very palatable. On account of the fact that age is essential to the development of the best flavor in beef, we find it necessary to compromise between tenderness and flavor. Veal lacks the flavor of older beef. The yearling does not produce as well flavored beef as the two-year-old.

The flavor and tenderness of beef are also improved by the ripening process. A number of days, probably two weeks time, is necessary to develop the best flavor in ripening beef. There is in this process a breaking down of some of the nitrogenous compounds into extractives and into sarcolactic acid. The extractives improve the flavor, and the acid, by softening the sarcolemma, increases the tenderness of the meat. These extractives are not nutrients in the ordinary sense of the term, but are merely tonics or stimulants. Beef extract and clear broth contain very little more than this extractive matter and are almost wholly lacking in real food. In skimming from the top of broth the last of the gray scum which comes to the surface, we remove almost the last of the real nutriment contained and leave it little more than a stimulant.

We ordinarily consider that meat to be good must be fat and also that this fat must be well mingled with the lean—that is, the meat must be well marbled as we say. Now, just why is it that we fatten meat?

First: We fatten meat because lean meat cannot be successfully ripened. Lean meat is very watery; fat meat is comparatively dry; and lean meat will rot before it will ripen, because its watery condition affords so much better opportunity for bacteria to grow. Fat meat is also well protected from bacterial invasion by its surface covering of dry fat.

Second: The fattening animal takes but little exercise. From disuse its connective tissue softens and the meat becomes more tender.

Third: Fat meat does not shrink, shrivel, lose its moisture and become tough in cooking as does lean meat. Put a lean steak into a skillet to broil and in a moment it will be swimming in the water which has escaped from it. Put a fat steak in the same skillet and it will broil without loss of its juices and without nearly so much shrinkage.

In comparing meat from the different portions of the carcass we note the truth of some of the above statements. For instance, the muscles of the neck which are exercised a great deal are very highly flavored and make exceedingly rich broth. The tenderloin has not nearly the rich flavor of the neck, but is more tender because it is less used, hence has its connective tissue less developed. Further, the inside of the round, or the top, as the butcher calls it, for he lays the round with the outside down on the block, is much more tender than the remainder of this cut, and on this account in eastern markets is separated from the outer portion of the thigh, or round, and sold at a higher price. The outer portion of the round is tougher because it is exercised more, and is in contact with the ground when the animal lies down. The inner portion or top of the round may be distinguished from the outer portion by the fact that the rim of fat surrounding the cut is thicker on this more desirable inside than on the tough outside.

In separating a side of beef into its wholesale cuts the butcher cuts one rib onto the hind quarter; and the remaining twelve are left in the fore quarter; seven ribs constitute the prime rib cut, and the five forward ribs are in the chuck.

The plate is separated from the chuck by a line running from the point of the shoulder, back along the side horizontally to the posterior end of the prime of rib cut.

The flank is separated from the loin by a continuation of this line from the point mentioned to the stifle. The plate is separated into two portions, the forward part being called the brisket and the rear portion the navel end.

The cut called the shortribs is between the navel end of the plate and the prime of rib cut, and hence lies along the middle of the side.

The round is separated from the loin at the rump bone and the sirloin is separated from the porterhouse at the hip bone, the porterhouse being the forward end of the loin cut. The chuck is the shoulder.

Table I exhibits a cutting test on three sides of beef of different grades. For these data we are indebted to Swift & Company of Kansas City, Missouri. These figures compare a prime steer, a medium steer and a common cow. As will be noted, they differ but slightly in the relative proportions of fore and hind quarters, but there is a marked difference in the per cent of dressed to live weight, the prime steer dressing 61 per cent, the medium steer 59 per cent, and the common cow 50 per cent. The prime steer cost the packer a year ago, when this test was made, $5.25 per hundredweight, the medium steer $4.65 per hundredweight and the common cow $2.60 per hundredweight. These three carcasses brought the packer $8.02 per hundredweight, $6.79 per hundredweight and $4.79 per hundredweight, respectively, wholesale. The retail prices of these grades of beef in Kansas

TABLE I.

CUTTING TEST.

THREE GRADES OF BEEF.

Cuts.	Prime steer per cent.	Medium steer per cent.	Common cow per cent.
Fore quarter:			
Chuck	25.07	24.37	25.48
Rib	11.00	10.15	8.65
Plate	11.77	12.18	11.55
Neck (boned)	1.02	1.02	1.92
Neck bones	.25	.25	.96
Shank meat	1.79	1.78	2.40
Shank bones	1.28	1.52	1.44
Totals	52.18	51.27	52.40
Hind quarter:			
Round and rump	22.50	22.34	24.04
Loin	18.16	17.77	16.83
Loin point	1.02	1.27	....
Flank steak	.51	.51	.48
Flank trimmings	1.02	.76	2.41
No. 2 flank fat	1.53	.76	....
No. 3 flank fat	.77	1.52	1.92
No. 1 kidney fat	2.05	.25	1.44
1 Kidney	.25	3.35	.48
Totals	47.82	48.73	47.60
Cattle dressed	.61	.59	.50
Cost packers alive	$5 25	$4 65	$2 60
Wholesale price	8.02	6.79	4.79
Retail price	$10 46	9.60	7.42
Retailers margin	.30	.41	.55

City at this time were $10.40 per hundredweight for the prime steer, $9.60 per hundredweight for the medium steer and $7.42 per hundredweight for the common cow. This left the retailer a margin of thirty per cent on the prime steer, forty-one per cent on the medium steer, and fifty-five per cent on the common cow. These margins cover all the expense of business, the shrinkage caused through evaporation and the retailers net profit. It will be noted that the lower the grade of beef the greater was the retailers profit. This is directly dependent upon the correlated fact that the common cow and the medium steer cost the packer less in proportion to their value than did the prime steer. The retail butcher and packer make their biggest profits where the producer makes his least profit. As producers we are unfortunate in having low grade cattle to dispose of. There is less competition in the market for lower grades of cattle because of their abundance.

A study of this table shows that the principal difference between high grade and low grade carcasses was in the rib, neck, shank and loin. The low grade carcass was long of leg and neck, and thin in loin and rib.

There are a number of ways in which the wholesale cuts are divided up for the retail trade, but the usual method is about as follows: The hind shank is cut into soup bones. The tip end of the round is used as a pot roast, and the remainder of the round is cut into steaks, with the exception of the knuckle soup bone. The rump is usually sold as a roast without trimmings. It is a good piece of meat, but rather dry.

The loin is all cut into steaks. The rear end is the sirloin; the forward end, the porterhouse. They are divided at the hip bone. The first cuts of the sirloin are next neighbors to the rump and round and are very much like these parts in character. They are the least desirable of the loin steaks. The loin improves as we go forward, the fourth and fifth cuts being quite desirable steaks, as in these we begin to get into the tenderloin. The double bone loin steaks come next and are choice cuts. After two or three of these, according to thickness, we come to the hip bone porterhouse steaks, generally two in number. The best steaks in the loin are these hip bone porterhouse steaks, sometimes called the tenderloin cut, because they contain more of the tenderloin than any other steaks. The forward end of the porterhouse is cut into clubhouse steaks, about two in number, which do not contain any of the tenderloin and are about the same in character as rib steaks would be. They are usually sold at a lower price than the remainder of the porterhouse.

The prime of rib cut is made into roasts which may be left the full depth of the cut, in which case they are called standing rib roasts, or the ends may be removed, in which case they are called short cut rib roasts, and are sold at a higher price per pound. Whether the roast may be left long or cut short, the total cost of the cut will be almost the same, so that the economical way to purchase a rib roast is to buy it with the ribs left long, but broken so that the ends may be removed in the kitchen, if so desired, and cooked as a pot roast or stew at a later date. In case the roast is purchased short, the butcher simply sells the ends over again.

The flank contains a broad flat muscle known as a flank steak, which is a very desirable piece of meat if taken from a well fattened animal. There is no waste to it whatsoever. It is coarse in fiber, but very rich in flavor, and if carefully prepared is a very choice cut. In thin cattle the flank steak is not usually removed, the flank being made into rolled roasts or sold for stews. A rolled roast of the hind flank is one of the most economical cuts in the whole animal. It is good to eat, is cheap and contains no bone. The plate is usually used for corned beef, or is boned and made into rolled roasts.

The chuck may be cut into roasts or steaks, and in a high grade carcass contains better meat for the money than the rib. The first or hindmost chuck roast is the best. It is as good as a rib roast and is cheaper. The shoulder clod makes a stewing piece. The neck makes soup or mincemeat, and the shin a stew and several soup bones.

The retail value of a yearling steer weighing 900 pounds was computed on the basis of Columbia prices and totaled $50.44 for the carcass, or, including the hide and some other salable part, the total retail value of the steer was $61.03. The grade of beef represented in this animal costs at the present time $7.52 per hundredweight, wholesale, and in Columbia cuts out $9.34 per hundredweight retail. This is the best grade of prime native steer beef. This carcass could have been handled at prevailing Columbia prices on a margin of 24.2 per cent to cover expenses, shrinkage and profit. The grade of beef usually handled in Columbia now costs $5.00 per hundredweight, dressed, and if it cut out as profitable a carcass as this prime steer did, it could be handled at present retail prices on a margin of 87 per cent to cover expenses, shrinkage and profit. It is well to note, however, that wholesale prices of meat are low at the present time and butchers' profits are higher than they often are. Still the butcher can usually buy the kind of cattle he handles in Columbia at from $2.25 to $3.25 per hundredweight alive, and this estimate is not far wrong. The retailer fixes his scale of prices so that he can afford to do business at any price which dressed beef is likely to reach; then the lower the wholesale price of beef, and the lower the grade handled, the greater will be his margin of profit. It is to his interest to handle a low grade of beef, because he can buy this sort better worth the money than any other.

TABLE II.

COLUMBIA AND CHICAGO RETAIL PRICES OF MEAT.

Cuts.	Chicago prices* cts. per lb.	Average Columbia prices cts. per lb.
Neck (bone in)	2½	8
Chucks	6	10
Prime ribs	16-18	12½
Porterhouse	20-22	17½
Sirloin	16-18	15
Rump	10	10
Round	10	12½
Briskets	6	5-7
Shin	3	2½
Shoulder clod	10	10
Plate	4	5-8
Hind shank	3	2½
Suet	6	6-7

Chicago prices on No. 1 prime corn-fed native steer.

Columbia prices on No. 3 native heifer.

On basis of these prices the Chicago butcher does business with prime steers on a margin of 30 per cent. The Columbia butcher could do business on same grade of carcass at current prices on margin of 27 per cent.

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*Prices of Louis Pfaelzer & Sons.

Table II compares Chicago prices on No. 1 corn-fed native steers and Columbia prices on No. 3 native heifers. As will be noted by the inspection of the table, the cheaper cuts bring better prices in Columbia than in Chicago, while the higher-priced parts bring more in the city It should be borne in mind, however, that these prices are on very different grades of beef. Considering, however, that both are on the same grade of beef, we find that the Chicago butcher does business with prime steers on a margin of 30 per cent, while the Columbia butcher could do business with the same grade of beef at current prices on a margin of 27 per cent. Expenses of operating should be considerable higher in the city than in Columbia.

TABLE III.

PRICE OF EDIBLE MEAT IN PRINCIPAL CUTS.

Cuts.	Per cent inedible refuse.	Price per pound.	Cost per pound edible meat.
Brisket	23.3	7	9.1
Chuck	17.3	10	10.1
Flank	5.5	10	12.6
Loin	13.3	15	17.6
Neck	31.2	8	11.5
Plate	19.8	8	10.
Ribs	20.1	12½	15.6
Round	8.5	12½	13.7
Fore quarter	20.6	....	....
Hind quarter	16.3	....	....
Whole side	18.6	....	....

Table III compares the cost per pound of edible meat from the more important parts of the carcass; due allowance being made for the inedible refuse purchased. The edible portion of the round steak costs in Columbia 13.7 per pound. The edible portion of the rib costs two cents per pound in excess of this amount, while the edible part of the loin costs 17½ cents per pound, figuring the whole loin as it comes from the shop at 15 cents per pound. Chuck is cheaper than any of the other cuts in the back and yields edible meat at a lower price per pound than any other portions mentioned except the brisket, flank, neck and plate; all of which, except the best part of the hind flank, being distinctively of a low grade as regards palatability and ease of preparation. The more tender and palatable portions of the carcass and those which can be prepared for the table with the least effort are the ones for which competition forces us to pay the highest prices per pound. As a local butcher expressed it to me, "The kind of meat you people want to buy is the kind you can have ready for the table at 12:30 after you have stayed down town till 12:00 o'clock."

The writer once boarded with a German family in Minnesota, in which the housewife was more willing than many to spend hours in the preparation of a cheap piece of meat. I well remember a Thanksgiving dinner taken at this house. The good lady had spent her whole morning drawing shreds of bacon through the tough muscles of a jack rabbit with a larding needle. She was making marbled meat. We do not ordinarily think of eating jack rabbit, but through her industry she certainly made this a very fine victual. Our way is best; human life is too valuable to spend larding jack rabbits, but it costs more money to get the kind of meat we prefer.

BREEDING PURE-BRED STOCK AS A BUSINESS.

(Mr. Clarence Ragsdale, Moberly, Mo.)

Mr. Chairman and Gentlemen:

When I commenced working on the subject, I found it so vague and so indefinite that I hardly knew what was best to say about it. I finally thought best to take up only one phase of the subject assigned, and try to do something with that, and so I have written, in a rambling way I fear, about important points in "Breeding Pure-Bred Live Stock as a Business."

There are few men who start out in life saying "I will do such and such business, or follow a certain profession, and when I am of middle age I will have my affairs in a settled condition and can then realize the fruits of my early labor." Very few of us work to any definite plan, and keep at that work, until our ambitions are accomplished. We are led to take up certain lines of business by surrounding circumstances, parental influence or, more often than not, by the urgent need of earning the almightly dollar, the choice of the way to acquire it being a secondary consideration. We have, so to speak, been forced into a certain way of earning our livelihood, or have drifted into this or that business, instead of having deliberately chosen it.

This is especially true of the breeding of pure-bred live stock. Most breeders have made it a side issue, going on at the same time with some business which has perhaps accumulated wealth for them, and treating their live stock industry as a diversion, or an experiment instead of a money-making business. I take it that when we smaller fellows discuss the improved live stock business, as a business, we mean it as a money maker, not a mere money spender, and that if we pursue it we do so because it will bring in profitable returns in cold cash; at the same time we are much indebted to these men of station and of wealth who prefer building barns to building libraries and who would rather feed a balanced ration to their fine stock than grand dinners to a French actress. They do not spare money in the purchase of the stock itself, nor in the arrangements for housing and feeding and care. They make the animals and the conditions as ideal as possible. That is a good thing for us to think about, working to an ideal, a pattern.

There is good money in that thought, as well as a little sentiment. To have in mind an ideal shorthorn, or Poland China, or Cotswold, and to feed and breed and cull and strive every day to reach that standard is the same thing as saying, "my stock is better this year than it was last, and consequently worth more money." That is my first point: Have an ideal. A merchant who would attract and hold his trade is particular to be in the fashion and keep up with the latest style.

Fashions in pure-bred stock change, and come and go. Glancing through the advertising pages of the Breeders' Gazette, there you will see the names of certain families and strains of blood repeated again and again as an inducement to buyers. The Jersey bulletin is the same; on every page appears the magic words, "Golden Ladds," which just now is the fashionable and no doubt extremely worthy Jersey style; and the same with the swine papers. "Perfection" and "Keep-on" are the words to conjure with in the Poland-Chinas. These are examples of what is true in each of the breeds of horses, cattle, hogs, sheep and even chickens, in fact, in all pure-bred stuff. To meet general approval and command a ready sale, the pedigreed animal must own a strain of this notable and fashionable blood. Understand me now, I am not saying that what is the most fashionable and sells the quickest always meets your ideal and mine of what is truly the best. Great minds will differ, and in this connection we recall with amusement how a certain breeder of Jerseys, on exhibition at St. Louis, afterwards made a sale. In their sale catalogue they referred to some of their choicest animals in terms of praise, but added that they would not probably be wild and woolly enough to please certain judges. The fashionable style may not be your notion of the best, but as a business proposition I make my second point: Be in fashion and offer stock of the breeds most talked about and sought after. To understand clearly what are the leading lines of pure-bred stock and to keep in touch with the doings of the breeders and feeders, and buyers and sellers, close reading of various agricultural papers from week to week is a real necessity, and a great pleasure as well. Bulletins from the Department of Agriculture and State bulletins are a great help, a wonderful help; and it is a queer condition that, with these few I have mentioned and many more that I havn't time to mention, fairly holding out their hands and beseeching one to help them make him dollars, it is queer, I repeat, that the printing press is not kept running over time to supply the urgent demand for them. Missouri has good, helpful agricultural papers; close acquaintance with and careful study of the pedigree of animals is of great service, and often adds dollars to the price. Books, descriptive of the different breeds, and also those which treat of feeds, care, etc., pay a big premium on the investment; you see this point often, that it pays and pays big for the breeder to keep up with the times by reading and study. If the farmers of my county or of any county in our grand State could only see the possibilities of their farmholds, if they could only be so united as to see that they could become at least independent if not rich by disposing of the scrub stock, and all breeding any one of the breeds of beef cattle, of dairy cattle or of horses, or swine or sheep, anything in the line of pure-bred stock, according to the sort of land they have, and the kind of stock they like to work with best, if they only could and would do so, what a difference there would be, but when I say *if* I lean back in my chair and close my eyes and let my imagination run riot as in a dream. I see my county blossom as the rose; I see fertile fields, bearing heavy crops; I see blue grass and clover pastures, and, best of all, alfalfa, giving of their substance to big beef cattle, or to dainty dairy cattle; I see hogs whose eyes stick out with fatness, and whose backs are as broad as a farm mortgage, ready for the market, or show ring; I see the golden hoof of the sheep drifting like a white cloud hither and yon over the pastures; I see good fences, good roads, roomy barns, silos and comfortable dwellings, and I see a steady stream of money pouring into these farmers' pockets for all these well bred animals. Oh, if, then comes that awful *if* again, and with a rude hand knocks down my castle in the air and I can no longer dream, but must face the stern reality of the situation as it is. It is bad enough, and it stands just about like this: A well-to-do farmer here and there has bought pure-bred stuff, cattle mostly or hogs, paying a fair or perhaps a long price; these animals are well fed and cared for, and given some extra attention, since their owner considers that he has quite a sum of money invested in them. Thought is given to breeding them, and the young things are well fed out. Presently these men have good stock for sale. With the same sense they have shown all through the transaction, they advertise and sell this stock, making something in the deal. The stock becomes better and better through introducing new lines of blood and the farmers make a good thing of their investment. There are a few of this class, and it is to be hoped there will soon be many. They are the leaven which we trust will soon leaven the whole lump. They are in wonderful contrast to the other class of farmers, who, as I said a moment ago, make the situation so bad. These men buy as good stock as the others do, take them home and dump them out on their land. They thereafter receive no care and the scrubbiest of scrub treatment. They have to take their chances, and without suitable food, water or shelter, they are kicked and cuffed about and receive no extra attention whatever. Perhaps the females are mated with unregistered males, the increase is not made anything of, and the owner mentally kicks himself when he accidentally sees one of them and wonders why he was such a fool as to pay out good dollars for these poor critters. If he wants to sell them he does not go about it in a business way, since he takes no care of the pedigrees, and really is in ignorance of the value of what he has. A pretty dark picture surely, yet it is the truth. The man loses out on his stock, loses the money invested and gives the pure-bred stock industry a black eye in his neighborhood.

We little fellows, beginning in the business, perhaps don't have the situation so well under control that we can care for our animals as we should, but we are working toward that ideal I spoke of a few moments ago, and to reach it, it seems almost a necessity to have what you might call a personal acquaintance with each animal. Haven't you noticed in your herd of cows that there is always one cow who bosses the whole thing and is first in war and first in peace and another one who is gentle and patient and seemingly knows what you say to her and what you want her to do. You will remember how this individuality was brought out by the professor in charge of the Jerseys in the World's Fair test. He fed and cared for each cow according to his knowledge of her. That was a substantial and gratifying piece of work. Those cows were as different from each other as persons are. Even two hogs, stupid and gross as they seem to be, *differ*; one is less stupid than the other. We raised two pigs by hand one winter; called one Napoleon and the other Josephine. Napoleon acquired several tricks—would shake hands, nod and shake his head for yes or no, and ask for food. Josephine never learned anything; she just ate and slept, and while it has nothing to do with the point I am coming to, I might remark that both Napoleon and Josephine came to violent deaths. Napoleon was sold, and soon after that became overheated and died, and Josephine was killed on the railroad track. The point I have come to and trust to make is, that it is a part of the business and the great secret of successful business to care for and feed and shelter your stock and try to know them and study each one as an individual. Don't you believe it?

The spring of the year is the most interesting and attractive season because then the growth of plant life commences anew, and each bud and blossom is full of promise. Hopes of a bountiful crop animate the farmer and he goes forth to his daily toil with renewed energy. He plants carefully and tills his crops unceasingly that they may grow and bring forth, some ten and some a thousand-fold. He rejoices in the plant growth. It is also pleasing to note the growth of animals. Old Queen was a good cow, perhaps, but her heifer, which will soon drop her first calf, bids fair to become a more prolific milker than her mother, both in quantity and quality of the product. How do I know it? Because her sire was of a fine milking strain, and because she has had good care. Being larger than her mother, she no doubt has greater food capacity, and her springing udder and well-placed teats indicate an excellent milker. She is something to feel gratified over; she's bred up instead of down. That pure-bred brood sow down in the hollow with her young pigs has as fine, or, in fact, the finest litter she ever farrowed. There are two little gilts that are just about the thing, and a boar or two, that, when grown out, will be something fancy. The old sow is a fine specimen of her breed, and the boar was the best to be had in that part of the country. They ought to be good; they are the best pigs the farmer man has raised on his place. He is proud of them and likes to go out of his way a little so as to pass by the hog house and look at these, and scratch the old mother pig a bit, and see her babies, as they lie in a shining heap in the straw or run about to find out what sort of a world they have come to. The man is proud of his stuff, takes a pride in watching it grow and fill out, and all the time tries to breed it better and better. They will sell for more than the last litter the mother had, and his motto is, and he sticks to it like a nailer, "Breed 'em up, gentlemen, breed 'em up." See the point?

I should consider that I had omitted a very important item of the pure-bred stock business if I failed to refer to the advertising and selling of the stock. There are various good ways and means of reaching the public and calling the buyer's attention to the stock which is to be sold. A letter head, bearing the name of the farm and the owner, the sort of stock bred, and perhaps details of certain animals, calls the attention of correspondents to the business of the writer in a very nice way. Sales are many times made by this agency alone. Local advertising is not productive of many sales, although there is generally considerable buying and selling and exchanging among local breeders. An advertisement may be well written and attractive and yet fail to bring buyers because it is in the wrong paper. Agricultural papers which are filled with ads. of patent medicines and nostrum, and get-rich-quick schemes, are worse than useless for advertising stock, no matter how cheap their terms are, nor how great their circulation. They contain, for the most part, reading matter taken from high class papers and not credited to them. Rural route mail boxes are filled with this cheap trash, week after week by the publishers, whether subscribed for or not. About all they are good for is kindling fires. A well-written ad. in a good high-class agricultural journal will bring the desired results. Occasional advertising will be sufficient until the business becomes large enough to bear a standing ad., which, of course, is expensive. It is extremely beneficial to the business, however, if it does cost. It is mighty poor business to misrepresent the stuff either in an alvertisement or in correspondence. It is an old saw, and a true one, that a pleased customer is the best advertisement, and a man's reputation for fair dealing gets around among the people somehow. Considerable stock is bought "sight unseen," as the boys call it. The buyer depends largely on the pedigree and on the word of the seller. It is best to make good any dissatisfaction which may arise, if possible. It is not always possible, for some buyers couldn't be pleased, not if they had selected in person the animal purchased. It pays in filling mail orders, to send out animals which have been fairly represented in the correspondence, and to live carefully up to the rule to never make a statement in a letter which cannot be borne out by the animal under consideration. Advertise them as much as the business will bear.

In concluding this brief review of what I consider the most important thing in the improved stock business, to which you have listened so patiently, I will say that the outlook for the pure-bred stock business in Missouri is radiantly bright. Those who are in the business, either in a large way or a small way, have the opportunity of a life time before them. The demand for their stuff, if it is the right kind of stuff, will be steady and urgent. Everything points to it. Missouri has got a move on her. The St. Louis World's Fair was an eye-opener to thousands and thousands of people who did not know Missouri was on the map, let alone knowing what fine stock she could raise. Stock exhibitors from everywhere found they must reckon with Missouri before the prize became theirs. Nor has our beloved State been without honor and a representative at the recent Chicago International. A lot of people pictured the Missouri farmer as a long, lank man, barefooted, wearing little besides overalls and a hickory shirt, sitting on the porch of a rickety old dwelling, squirting tobacco juice from between his dirty teeth, and living chiefly on razor-back bacon, corn bread and sorghum molasses. He went to town in a ramshackle old wagon behind a lame mule and an old blind horse, hitched up together, and his women folk with him sitting flat in the bed of the wagon. He may look like that to some; to me he looks very, very different. To me he looks like a strong, sensible man, dressed in a well-fitting suit of good clothing. He sits on the vine-covered porch of his comfortable cottage home, and has in his hand a daily paper. His bill of fare is, this time of the year, Berkshire sausage for breakfast, Shorthorn rib roast for dinner and Hereford porterhouse steak for supper. He has roast Mammoth Bronze turkey or Plymouth Rock old hen with dressing for Sunday dinner. His table is supplied with Jersey butter and cream, Holstein cheese, clover honey, made by Italian bees, and grape or current wine on the side. When he drives to town, it is behind a thoroughbred team, and he and his family are in a comfortable carriage. That is my notion of a typical Missouri farmer. And when more and more farmers get into the improved stock business, as they will—there is no question of it—they will become even more comfortable and more thrifty than I have pictured this one. The price of farms in Missouri is getting higher and higher. Farmers from adjoining states, who have sold their land at a long price per acre, come here and buy cheaper land and, making money by the move, have a little surplus which enables them to buy pure-bred stock and conduct their farming on a wider and more profitable basis. Somebody once said that if Missouri were inclosed within a high wall and forced to exist within herself, she could produce everything necessary to sustain her population in comfort and luxury from her own resources, and with no outside help. We Missourians are proud of our State—proud of her resources, proud of her advance in the line of pure-bred stock, and willing and desirous to see the time come when the greater part of her farmers shall go into one or another branch of this excellent business—breeding pure-bred live stock.

DISCUSSION.

Mr. Boles: I was very much interested in that paper; and I will say that I believe in a man making a business of any business that he undertakes. To a beginner in the pure-bred business I will say that it would be best for him to start with a tried animal. Sometimes we get an idea that we want to buy a show animal and sometimes we buy something that is untried. I have always found that it is better for me to buy some old cow rather than some untried heifers. We are not supposed to know all about the pure-bred business when first starting in, and it is because we don't get started right that we become disgusted and quit the business so often. I remember my first experience in buying sheep. I went to the St. Louis Fair and I bought three ewe lambs. I made a mistake in the whole business, only one lamb proving a success. The ewe lambs are all right, but I had to wait too long to get my money back. And I learned that it would pay me better to buy the older sheep, and the same with my cows. I bought seven or eight two or three-year old cows. Those cows have all paid for themselves and left me a profit. Another point in which I have made a mistake, and that is in selling stock and not giving the pedigree. Sometimes a man buys an animal and don't care anything about its pedigree. Sometimes we have pure-bred stock that we cannot pedigree. I had a little experience in that not long ago, and I think it was detrimental to me. If we cannot pedigree our stock we had better not put it on the market at all as a breeder. When you sell a man anything give him the pedigree, whether he wants it or not. I gave a man a pedigree once and he twisted it up and put it in his pocket, and I guess he lighted his pipe with it the first time he wanted to smoke. That made me feel like I had done a lot of work for nothing; but sometimes we find the pedigrees are worth a great deal to us. Whenever you buy an animal have him registered; get the fellow from whom you buy it to have it registered if you can, but if not, get the pedigree so you can have him registered whenever you want to. Another thing I would say in regard to the pure-bred business—educate yourself—know what you are doing. Find out whether or not you can depend upon the man with whom you are dealing. That is the first question. If you cannot depend on him don't have anything to do with his stock. That is my theory. In order to know these things you have got to attend these meetings, and attend the shows and get acquainted with the breeders. Then, you must read the agricultural papers. There is no man who can keep up and not read, and no man can know what he is doing and be posted without knowing who are responsible breeders.

And then about advertising. Even if you don't have anything to sell at the present time, it is a good idea to keep your name before the people all the time. Let them know you are still in the business, and I am sure it will pay you.

Mr. Ragsdale: I would say to any young man who wants to start in the breeding business to first find out what kind of animal he wants, and then, when he goes to the breeder, just tell him he is from Missouri and wants to *see* the papers. Insist on getting the papers.

POLLED HEREFORD CATTLE.

(Hon. B. O. Gammon, Des Moines, Iowa.)

It seems indeed like labor lost to bring word of an improved type of Hereford cattle to Missouri. Missouri, birthplace and home of the mighty Defender, peerless leader of a peerless breed; Missouri, whose five hundred pure-bred Hereford herds make it the very Herefordshire of America, who would presume to improve upon the Missouri Hereford? But at the invitation of your program committee I am here to discuss what the world must deem an improved type of the "whiteface," the Polled Hereford.

The ultimate outlet for the products of every herd of beef cattle is the shambles. Whether we produce breeding cattle or feeding cattle, we all meet on the road to the slaughter pens. If we are to succeed we must be ever ready to supply the demands of the butcher, our final common patron. Between us and the butcher there usually come two important intermediaries, the feeder and the shipper. And all these men, feeder, shipper and butcher, are demanding today, as never before, that beef animals shall have no horns. The men who handle the steer while he is preparing for the packing house note some essential and very well defined differences between the horned and the hornless beef. The feeder knows that the hornless animal will gain faster, needs less shed room, is more docile and altogether more pleasant and profitable than the horned one. The shipper has learned that there are no broken horns, gouged eyes or disemboweled cattle when a load of hornless ones reaches market, and he has felt, too, the cut of $1.00 to $3.00 per head that the buyer gives the horned steer, and he avoids it as a plague. The butcher notes the bright carcass, free from bruises, and the evenly marbled flesh of the quickly-fattened steer and unites with the others in demanding a hornless beef.

Although this demand has been recognized in the past, and more especially in the recent past, the breeder of Herefords has had no way of meeting it save by the saw. And the dehorning saw has its very great disadvantages. On the range it presents serious practical difficulties, and everywhere it results in a temporary check to rapid growth, often in losses by death, and is always accompanied by the frightful brutality of intense pain. No matter how humane the operator or the method, dehorning is a disgusting, unpleasant job, detested by every lover of animals, and what successful stockman does not love them?

Hence, we see the crying need of a naturally hornless or polled strain of Herefords.

To supply this need the American Polled Hereford Cattle Club was organized at Des Moines, Iowa, in 1900, for the purpose of establishing and building up such a strain. We at first held the opinion, so prevalent among breeders, that our only method would be to make use of an outcross with some established polled breed, such as the Polled Durham, Angus or Galloway, coming back immediately to the Hereford and continuing to infuse Hereford blood until such high grades were attained as would be practically pure bred. In other words, we expected to produce just such a breed as is the Single Standard Polled Durham, cattle practically pure bred, but with just enough alien blood to give the polled head. However, upon a study of Darwin's "Origin of Species," in which we became much interested about that time, we were convinced that there must be freaks or sports among pure-bred Herefords as among all other species of animals, and that if they could but be located there were probably in existence sport or freak Herefords having no horns, though of pure-bred horned ancestry. We determined to make a search for such freaks, and by correspondence with the members of the American Hereford Cattle Breeders' Association, we located seventeen such animals, four males and thirteen females. We bought the four males and seven of the females and mated for the first time in history a hornless Hereford bull with a hornless Hereford cow for the express purpose of producing polled progeny. We were successful, and from that small, though far from insignificant beginning, we have gone on in our operations until we now have a promising start toward a fixed and, we believe, increasingly popular strain of beef cattle.

Though two of the original four males have proven worthless as breeders, we have located two more, and so have four unrelated bulls to use in avoiding detrimental inbreeding. These males and their oldest calves are busy in good herds of cows possessing some of the best blood lines in the Hereford Herd Book, and are producing polled calves of high merit. In our own herd we had twenty-two polled calves this year, thirteen being males. There are males in use in well-selected herds in Iowa, Illinois, Indiana, Nebraska, Wyoming and Canada.

While we were breeding the single standard cattle many became interested in them, and we now have upwards of fifty breeders raising this class of cattle. Under the rules for entry of cattle in the Single Standard Polled Hereford Record, the cattle offered must be sired by either a registered Polled Hereford bull or a pure bred Hereford bull, and their dams must be sired either by a registered Polled Hereford bull or a pure bred Hereford. This rule results in nothing less than three-quarter Herefords being admitted to record as single standard Polled Herefords, and as a matter of fact, the bulk of the cattle entered during the past year are from seven-eighths to thirty-one-thirty seconds pure bred.

I trust you have it clearly in mind that single standard Polled Herefords are cattle naturally polled and possessing the Hereford markings and type and a very large fraction of pure Hereford blood, but having a slight mixture of alien polled blood from some established polled breed, while double-standard Polled Herefords are pure-bred registered Herefords, which either are freaks of nature (so-called "sports"), or are the progeny of such sports. A double-standard Polled Hereford is nothing more nor les than a pure-bred Hereford, naturally polled or hornless. He sires polled calves with certainty, and is no longer either a product of chance or a creature of accident.

Now, a word as to the individuality attained in this new breed. It stands to reason that you can pick a larger number of superior animals from a herd of a thousand than from a herd of a hundred, and since there are relatively so few Polled Herefords (I am speaking always of Double Standards) in existence, no one need expect to find every one a show animal. But this is true in breeding, that when an organism sports or varies from the parent type in a new and pronounced way, there seems to be a breaking up of the old-settled lines of heredity or inheritance, and variations in several lines are apt to show up in the resulting progeny. This principle explains the fact that some of our Polled Hereford bulls throw calves far superior to themselves, and when mated with only ordinarily good cows, produce some really excellent progeny. Another fact beyond dispute is that the Herefords as a breed respond most readily to care and management. There being so few Polled Herefords in the country they are all given extra good treatment, and this results in bringing out all there is in them as indviduals. In this way we have succeeded in producing what we think are some very creditable specimens. Indeed, a Polled Hereford took second place in the Hereford ring at the Wyoming State Fair last fall.

We are frequently asked, "How many generations removed from horns are your cattle?" To this we must reply, "Not many." There are bulls whose dams, granddams, aunts and sires are all polled and heifers of the same breeding. Within a few months we expect to have polled calves whose dams, granddams, and great-granddams, sires and grandsires are polled.

The future of the breed looks rosy. The demand for breeding stock has been phenomenal. We could have sold fifty head where we have been able to produce one. In December last we placed some spring calves in offer by writing out eighteen letters to men who had expressed an interest in the matter. Within a week we had seven replies, all asking that one or more calves be reserved. Prices have consequently ruled strong calves at weaning time commanding $250 to $500. Many parties have bought pure-bred horned heifers in calf to our herd bull and raised their own polled stock. One man put $1,700 into a small herd of Hereford heifers, bred them to our bull, and recently refused for his first crop of calves $2,000. Like all other new enterprises, it started slowly, but it has now gained an impetus that nothing can overcome, and the Polled Hereford, an accomplished fact, is here to stay. The Hereford fraternity, at first questioning the possibility of producing a polled strain, is awakening to the importance of this new breed character, and many of them are only waiting for a bull to take up the enterprise. Breeders of other beef breeds who like the Herefords, but dislike the horns, and so selected a hornless breed, are warm advocates of this new Hereford. Demand produces a supply, and ere many months we expect to have herds in every state of the pure-bred cattle belt and, gaining strength with numbers, we look forward to an unprecedented growth and popularity.

I would not have you imagine for a single moment that you must put aside all your favorite blood lines when you start with this new breed, for by crossing a polled bull on cows of any desired family, you can produce polled calves of any blood you wish. We have resorted very largely to this mating of horned Hereford cows with polled bulls in building up the individuality of our herds, since we can cross upon cows of as good type, conformation and pedigree as we desire and produce calves as good as any ones. Judicious inbreeding can be used in fixing the polled character, and thereafter we can breed in any line desired. We do not come to you with a new and untried breed of cattle, but simply taking advantage of a commercially valuable variation, we propose to engraft it upon the established breed and add much to its present high value while detracting in no way from its well known merit.

Among a lot of queer notions prevalent everywhere concerning Polled Hereford cattle is the idea that they are uncertain breeders and not true to type. That one year a bull may sire a few polled calves, the next year many, and perhaps the third year none. Furthermore, that the percentage of polled calves will be small, say 10 to 15 per cent. This is an error, as is demonstrated by the experiences of all our breeders. A "sport," or original polled bull or a polled bull with one horned parent, will sire from 50 to 75 per cent polled calves when used in a horned herd. In the average of many years it will probably run about fifty per cent. When mated with polled cows with this same amount of polled blood, such a bull will sire from 75 to 100 per cent polled calves. In-bred or line-bred bulls are, of course, more prepotent in dehorning than are others. There is as much certainty in results to be anticipated by the Polled Hereford breeder as by any other class of breeders. We have not repealed the laws of inheritance, we are but using them to our own advantage.

Concluding, allow me to suggest, with all due respect to every other worthy breed, that we have in Hereford cattle one of the thriftiest, hardiest, "hustlingest" and most profitable breeds of beef cattle in existence, a breed that feeds magnificently, matures very quickly, has a quiet, docile temperament, breeds surely and prepotently, bears a famous trade mark in its clean white face, and can acquit itself with honor anywhere. It is faulty in one essential, its heavy horns. If we eliminate this fault we can match the Galloway for hardihood, the Angus for finish or the Shorthorn for scale. The day is not far distant when all beef cattle will be polled. Men will produce what other men will pay for, and the other men are paying more liberally for hornless cattle. The Angus and Galloways have been polled as long as we have any knowledge of them, the Shorthorns produced the Polled Durhams not many years ago, and now the last, though not the least, of the great beef breeds is being dehorned by science instead of the saw. Hereford men have now the opportunity to remove the most glaring fault from their cattle, and do it at a profit. Surely one is not very wrong to suggest such an improvement here in the heart of the Hereford country. Gentlemen, I thank you.

THE MANAGEMENT OF A PURE-BRED HERD.

(E. B. Mitchell, Olinton, Mo.)

As this topic covers such a vast area and is governed by so many conditions over which we have no control, it would seem that there could be no rule that will apply to different localities.

However, the first thing to be taken into consideration would be the object we expect or hope to obtain, and it seems to me that in this progressive age of high-priced land and labor there should be but one place to strive for, and that is as near the top as possible. It matters little how successful you may be as compared with your fellow-breeder, or how nearly you may think you can reach the pinnacle of success, there is always that something in the distance, that hope and desire to accomplish something just a little better, to stimulate and encourage us to reach just a little higher degree of perfection in the production of animal life. No man has yet produced a perfect animal, and this very fact will, of itself, stimulate and encourage the ambitious breeder.

Having thus outlined my views concerning the objective point in a breeder's career, I desire to go further and state that I am a firm believer in the selection of specialties as the surest and safest road to success. The breeder who can and will formulate in his mind the perfect animal, whether it be a draft horse, light harness horse, beef animal or dairy animal, and exert every effort and lend all his energy to the production of this one class, will come very much nearer materializing his ideal than the man who scatters his shot at two bulls eyes, usually shooting just between both. In other words, the animal bred for the purpose of combining two qualities must of necessity take a mediocre position competing with animals bred especially for either the one or the other.

"Oh, but," says one, "we breed sheep for both wool and mutton, why not cattle for both beef and milk?" We do combine both dairy and beef qualities as successfully as do our friends breeding sheep. But has any one yet produced a Southdown carcass of mutton with a Merino or Ramboulette fleece? I answer "no." As no man can serve two masters, I believe it a physical impossibility to divide ones attention to the development of two qualities in one animal without becoming top heavy one way or the other, thereby sacrificing one quality to the development of the other. This being, in my judgment, human nature, it brings us to the necessity of specializing in the production of the highest types of animal life.

My preference being for beef cattle, and what little experience I have had having been along this line, I shall attempt to tell you how I manage the cattle now in my charge—and do not wish to be understood that I consider my plans anything like perfect, for by constant care and watchfulness I find that they can be very much improved upon. Neither will my plan be feasible in more northerly countries where the winters are more severe, but as regards climate we are certainly admirably located and have it within our power to give to animals what nature intended them to have, the run of good pasture and plenty of pure air. I long since learned to appreciate fresh air and outdoor life under natural conditions in the rearing of pure-bred cattle.

I prefer having as large a per cent of calves as possible during the fall and winter months, beginning as soon after September 1 as possible (as you are well aware a showman never has any calves dropped prior to September 1st). Our early calves coming in September and October, are allowed to stay with their dams in pasture the first three weeks of their lives, not, however, with the herd, but in a small pasture kept for this purpose. After reaching this age the dams go to pasture with the herd, coming in to nurse morning and night, and in the pasture used for nursing calves we keep a trough low enough to the ground so that almost the smallest calf can reach and feed in this trough at all times. It is surprising how soon a little calf will learn to lick a little feed of bran and ground oats. As soon as the weather becomes stormy the calves are brought to the barn into what we call the calf pen, a covered shed twenty by fifty feet, with the upper half of the south wall open, which is never closed. These calves are given the run of a yard of about a half acre every day in winter, with plenty of fresh water and feed before them all the time.

The dams are brought to the barn evenings and kept in at night, allowing the calves to nurse night and morning, and the cows going to pasture every day in winter as in summer.

At three months of age all the bull calves are removed to other quarters, similarly constructed, and handled the same way.

On the approach of grass, say April 1, we select a warm day, and every animal on the farm is put through the dipping tank to eliminate lice or any skin trouble that may exist. The cattle are then all classified as to ages and go to their respective pastures, yearling heifers in one pasture, two-year olds in another, dry cows in another, the nursing heifer calves to another pasture, the nursing bull calves to still another, and the dams of each separated in different pastures, coming to the respective yard to nurse. We continue feeding the calves on grass, so that by the time they are ready to wean they never notice it, but go right on with their growth, entering the second winter in fine condition and, in fact, what a great many men would call fat. During this winter every good day these heifers go right out to their pasture, coming in at night to a yard with a shed open to the south, and are fed about four quarts each night and morning of a ration consisting of two parts bran, two parts ground oats, and one part ground corn by measure, with all the good timothy or clover hay they care to run to. During this winter and the following spring all of the bulls of this crop of calves should be sold, and the following summer the heifers are fed once a day in the pasture about one gallon of such feed as above described. By the following fall, or by January 1, all of these heifers should be bred and in calf, and are kept right out in pasture all winter with timber for shelter and fed twice a day with plenty of good hay for roughness.

We try to have our two-year old heifers approach calving time in very strong flesh, and by constantly growing them from birth this can be accomplished with little or no risk, and right here let me say that the best way I know of to produce thick-fleshed cattle is by giving them the habit cultivated through sire and dam from generation to generation.

Every man has his fads, and this feeding question is one of mine, and one that in my judgment has been more disastrous (not however that of feeding but lack of feeding among breeders of pure-bred live stock) than any one thing connected with the business.

Did you ever have any one admire or compliment you on the production of an animal that is so thin in flesh that it must walk twice in the same place to make a shadow? Is it not always the fattest animal you have that sells first?

The first season that a young cow nurses a calf is, in my judgment, the the time they require the most care. Take the heifer through this period in good flesh and you will have no trouble in the future to retain that condition; on the contrary, allow the heifer to grow thin and emaciated during this period and you will always have a thin, poor cow. I try to give to each cow about three months of rest between nursing and calving, and for this purpose I reserve the most quiet, coolest and coziest pasture on the farm, not one with grass over which the cow must work the greater part of twenty-four hours to gain a living, but with grass to their knees, so that they can soon fill and lie down in peace and comfort, and by calving time they are usually quite fleshy and prepared to do their part in raising their offspring.

I do not know how successful other breeders are in having their cows produce calves within the twelve months, but about eighty per cent is for me an average.

Our herd bulls are never allowed to run with the cows, but every cow goes to the barn for service, and is kept by themselves for several hours thereafter or until they are sufficiently quiet to return to the herd. The bulls are given the run of the paddock each day in winter and a good grass lot all of the nights in summer, and in case a bull is not disposed to exercise enough, as they sometimes will be, he is made to take it by being led at least a mile every day. I think a great portion of the trouble breeders have with bulls in high condition is owing to lack of exercise. Give them plenty of it and flesh will never hurt him if put on with proper feeds. I prefer keeping my herd bulls almost ready for the show the year around, as I am a firm believer in the adage of that veteran showman, Uncle Thomas Wilhoit, "Thick-fleshed cattle produce thick-fleshed cattle."

But I hear someone say, "Oh, I can't afford to keep my cattle in that condition—feed my cattle twelve months in the year?" My friend, if you have never tried it you don't know whether you can afford it or not, and I say you can't afford not to. These cattle must be sold sometime, that's what we all breed them for; then if you choose a public auction and do not put your cattle in the best possible condition you suffer, and so does the purchaser. If you do put them in condition and have allowed them to get thin in flesh it will cost you more money per head to get them ready for sale than will the method I have outlined. But the best and strongest argument in favor of good keep, or in other words, growing them good, is the fact that they are always in sale condition, and if a prospective purchaser comes to your place he is almost sure to find something to please him, or if you desire to make a draft sale, there is no especial fitting to be done.

The breeding of pure-bred live stock must of necessity resolve itself into a commercialism, and we as breeders, should treat it as such. It is not a plaything for the millionaire nor a fad for a man of moderate means, but a business proposition pure and simple, and will admit of and requires as much mental exertion as can be concentrated in one particular line.

We are next brought face to face with the most perplexing problem of the business, that of creating a satisfactory demand for our produce. Printer's ink has its value which, by the way, is of no mean proportion, but the fact that every man wants to be shown convinces me that it is up to us breeders of improved live stock to show him. We may breed the very best cattle in the world, but if they are allowed to remain on the farm we have little opportunity to compete in trade with the man who keeps constantly before the public as an exhibitor in the great shows of this country which, by the way, are second to none in the world. We are all encouraged in the work by our Live Stock Association, which offer very liberal prizes for representatives of their breeds, and there is no way by which the breeder can so successfully keep before the public as to exhibit a few animals each year. True, the man who sufficiently appreciates the value of this method of advertising to follow the shows each year incurs the risk of being dubbed "A Professional Showman." Be this as it may, however, the value of the show as an advertising medium is not depreciated one particle. We rear our live stock, develop it well and place it before the public to find ready sale at good prices and enjoy the prosperity due us. So we must give due credence to the careful, conservative management of the pure-bred herd.

THE VENTILATION OF DAIRY STABLES.

(Prof. F. H. King, Madison, Wis.)

The necessity of a sufficient supply of air for the maintenance of life activities, both in our own case and in our domestic animals, is well recognized and sufficiently appreciated; but we do not understand in how many ways and on how many occasions the amounts of pure air are cut down far below the requirements of health and vigorous normal bodily functions. It is a lamentable fact that, even in our own case, to say nothing regarding our domestic animals, wherever we congregate in considerable numbers in warm compartments, in the great majority of cases entirely inadequate provision is made to change the air as rapidly as it should be changed. This general lack of adequate ventilation results partly from an insufficient knowledge of the amount of air which is daily required for respiration, of the degree of purity at which it should be maintained, and of the bad effects which result from the long-continued breathing of air too impure. It results partly from not sufficiently realizing to what extent warm, close compartments and stables interfere with a rapid interchange of the air in them. And partly, also, from not knowing what remedy to apply when the difficulty is recognized.

AMOUNT OF AIR BREATHED DURING TWENTY-FOUR HOURS.

To burn one ton of hard coal requires something like 11 tons of air; and to burn a ton of wood there must be passed over it 5 full tons of air, supposing that the entire amount of oxygen carried by the 5 tons of air could be appropriated by the wood. This, of course, cannot be done, and hence there must be supplied, to maintain rapid and complete combustion, larger amounts than these. But the consumption in the stable, by the dairy cow, of a ton of hay or a ton of grain, requires that there must pass into her body through her lungs, for each and every ton, something like 5 tons of air. But to contain a single ton of air at ordinary temperature and pressure requires a stable 50x50x10 feet.

We breathe in 24 hours 34 pounds of air; a cow breathes 224 pounds; a horse 272 pounds, a pig 89 pounds, a sheep 58 pounds, and a hen two pounds. In the case of the cow, the amount of air she must breathe daily is more than double the weight of the water and dry food she uses. Let me put these quantities before you in another way:

Were we obliged to store air in bins, as we do grain, to contain the amount required for a man for a single day would necessitate building one 8 feet on every edge; for a horse there would be required one 15 feet; for a cow one 14 feet; for a pig one 10 feet; for a sheep one 9 feet; and even for a single hen there would be required a bin 3 by 3 by 3 feet to contain the amount of air she breathes during a single day,

Stating the amounts of air required daily in still a different way, let us suppose that it were necessary to pump it from the ground as we now draw water; then to supply the needs of one man it would be necessary to pump and bring to him each day 1,275 pails full, such as will hold 21 pounds of water; to supply the needs of a horse there would have to be drawn 10,203 full pails; for the cow, 8,412 pails; for the pig, 3,309 pails; for the sheep, 2,178 pails; and for one hen of average size there would have to be drawn no less than 75 full pails of air to meet her daily needs.

AIR ONCE BREATHED NOT FIT TO BREATHE AGAIN UNLESS DILUTED.

As the air leaves the lungs it has been so largely depleted of the oxygen which it carries and is so highly charged with carbonic acid gas that a burning candle will be extinguished when lowered into it. This may be readily demonstrated by breathing through a tube into a wide-mouth pint bottle and then lowering a lighted taper into it, for it will then be quickly extinguished. If one takes an ordinary tubular lantern and gently passes air from the lungs through a tube into the supply tube above the lantern globe the flame will be quickly extinguished. So, too, will it be extinguished if a lighted match is held beneath the draft flue above the lantern globe. In this case the burning match withdraws the oxygen from the air in the same manner as is done when the air is breathed and the flame is extinguished for want of it.

Besides the removal of oxygen from the air and the substitution of carbon dioxide in its stead, there is also thrown off from the system through the lungs a large amount of moisture and marsh gas, some ammonia and other gaseous products, some of which are poisonous. Brown-Sequard as long ago as 1887 condensed the products of respiration by passing them through water and succeeded in obtaining therefrom a poisonous product which, when injected into the blood of a rabbit, caused death. He at that time was inclined to look upon this body as one of the poisonious alkaloids. If in a stable provided with a ventilating shaft, which is serving a large number of animals, one places himself so that he must breathe the air passing up the shaft, the air will be found to be very oppressive and often to the extent of producing nausea. So, too, in a closely built stable housing a considerable number of animals the air in the morning, after the stable had been closed all night, may be found to be so offensive as to produce nausea, or at least a disturbed uncomfortable feeling.

SIGNS OF INSUFFICIENT VENTILATION.

The evidences of an insufficient supply of air passing through the stable to meet the needs of the animals are very unmistakable, once they are understood. A feeling of closeness, the smell of ammonia and of offensive odors, and particularly a dampness of the stable, which results from the condensation of moisture on the ceiling, walls and sometimes on cement floors. Such conditions are particularly liable to be observed in basement stables, not because the basement is the originator of them, but simply because their walls are usually so much closer than the walls of over-ground stables that the ventilation is less perfect unless provision for ventilation is made specially.

IMPORTANCE OF A CONTINUOUS AND ABUNDANT SUPPLY OF AIR IN STABLES.

Everyone knows that a complete cutting off of the supply of the air from the system for even a period of a few minutes results in very serious consequences. This is because many of the most vital processes of the body require a continuous and abundant supply of air for their maintenance. Of ordinary food materials and of water there are stored in the body, in more or less completely available forms, considerable quantities which may be drawn upon in cases of emergency when the outside supplies are cut off. We may go days without water and weeks without food, but the supply of air from the outside must be continuous, as the available reserve is very small indeed.

It is true, however, that very notable deficiencies of oxygen may exist in the air of a stable for considerable lengths of time without fatal consequences resulting. But never without both reducing the rate of vital activities and distorting their normal course. Under such conditions the blood is not adequately purified, the system is poisoned, its tone is lowered and the animal is predisposed to disease. We must never forget that the germs of very many diseases are always about us and about our domestic animals and even within their bodies. They are there, but held in abeyance, just as weed seeds in a soil are prevented from developing so long as a vigorous crop is kept growing upon the field. In the very dry season of the great Chicago fire there swept across a forest section of Wisconsin a tremendous conflagration which denuded of everything green a stretch of country some 15 miles wide and 50 miles long, leaving entirely naked ground, which became so much heated in places as to bake potatoes in the isolated patches in the clearings. To the great surprise of the survivors of this terrible fire there sprang up on the naked ground the next spring a great profusion of forms of plant life not common to the district before the fire. Poplars, giant willow herbs, raspberries, black and red, and blackberries sprang up, forming an almost impassable jungle on the drier lands; while cat-tails in the greatest profusion took possession of the swamps where they had not been known before. Of course in the years before the fire the winds and the birds had sowed and kept sowing the woods and the swamps with the seeds which lay there dormant biding the time when a favorable opportunity should offer for them to spring into full possession of the soil. This came with the fire which swept the forest away. And so it is with us and with our domestic animals. Anything which weakens the normal vigor of any organ of the body tends to make of that organ, if I may be permitted the figure, a burned over district in the tissues of the body forest in which disease germs, perhaps already planted, tend to spring into mastery, bringing sickness and perhaps disaster. And so, beyond a shadow of doubt, inadequate stable ventilation is one of the strong predisposing causes to tuberculosis, tending to give the germs, ever about us, an opportunity to spring into overmastering growth in some organ of the body.

BODILY COMFORT OF STOCK MEANS ECONOMY OF FOOD AND INCREASED PRODUCTIVE POWER.

Recent physiological researches conducted at Cambridge, England, throw new light upon the functions of sleep and undisturbed rest; of perfect mental and physical quiet in giving the body renewed power to do. In a study of the causes which influence the blood pressure it was found that during perfect sleep and times which permit the most complete rest, physical and mental, the blood pressure reaches its lowest limit. It is believed that this lowering of the blood pressure results from a pouring out of the circulatory system upon the tissues which need to be nourished the nutritious portions of the blood, so that they are thereby bathed in it and fed. Any thing which disturbs the animal mentally or physically increases the blood pressure, it is held, by withdrawing again from about the tissues into the blood vessels the fluids which nourish them. It is held further that anything which increases the activity of organs or causes excitement or produces a condition of unrest tends to lessen the tendency to pour the nourishing fluids out upon the tissues so that a slower rate of building or replenishing of waste must then take place. If these observations and conclusions are correct then it follows that a comfortably warm, well ventilated stable, where the cows may lie at perfect ease during the intervals between feeding, must contribute toward a higher productive power. No person can get a night of undisturbed restful sleep under conditions where the air is foul from inadequate ventilation, and so it is in a stable crowded with stock where there is an insufficient movement of air through it. Sound sleep, strong digestion, complete assimilation and high production can only be secured in well ventilated and otherwise comfortable stables where the winters are severe.

TEMPERATURE OF STABLES.

The bodily functions only go forward normally when the temperatures within the tissues are maintained at about 101 degrees F. for the horse; 102 degrees for the cow; 103 degrees for the pig and 104 degrees for the sheep. When the surrounding conditions are such that heat is lost rapidly from the body, there is no other alternative than that the internal energies of the body must be turned into heat to a sufficient extent to make good the loss. Observations have demonstrated that, in the case of a man at rest and fasting under a room temperature of 59 degrees, the consumption of oxygen in the body and the loss of carbonic acid from it was 13 per cent greater than it was when the body was placed under a surrounding temperature of 90 degrees. This means that to maintain the loss of heat from the body at the lower temperature 13 per cent greater transformation of assimilated materials within the body was taking place, and that there was this much less left for other work; or, if there was no reduction of other work, that a larger amount of food must be taken into the system and assimilated there.

We have as yet no sufficiently exact and extended observations to make sure what are the best stable temperatures for stock. We know that it may be some degrees below 72 degrees F. for dairy cows. It is quite certain, too, that the best temperature will be found to be some degrees above freezing, perhaps between 45 degrees and 60 degrees for cows being fed high for milk and between 50 degrees and 65 degrees when they are on a maintenance ration. But to maintain such temperatures as these during our winters north of the Ohio river requires the construction of warm stables; and where warm stables are built for any considerable number of animals provision must be made for adequate ventilation.

VOLUME OF AIR WHICH SHOULD MOVE THROUGH A STABLE.

From various considerations we have assumed that we will be on the safe side if an air movement through the stable is maintained at such a rate that the animals are at no time compelled to breathe air which contains more than 3.3 per cent of air once breathed, and that with stables, having reasonably warm ceilings and walls, the moisture, given off by the animals from skin and lungs, will be removed rapidly enough so as not to condense upon the walls. If our domestic animals were obliged to stand continuously in the water from which they must drink, as they do in the air they are compelled to breathe, we would have no difficulty in realizing that a rapid flow of water across the floor of a stable of 40 cows, even if it were deep, would have to be maintained in order that it should be sufficiently pure to be wholesome drinking water.

Suppose a cow were placed in an air-tight compartment 40 feet wide and 10 feet to the ceiling, how long would it have to be to hold enough so that at the end of 24 hours only 3.3 per cent of the air would have been once breathed? 231 feet. The volume of air required for a horse during 24 hours would necessitate a similar room 262 feet long; for a pig, one 82 feet; and for a single sheep, one 55 feet in length. From these statements it will be clear that the provision for needed air supply must be one of rapid change of air in the stable, rather than one of capacity. The necessity is for cubic feet of air moving continually in and out of the stable, rather than cubic air in the stable at any one moment.

To supply 20 cows with air of the degree of purity stated requires a ventilating flue 2 feet by 2 feet, through which the air moves at the rate of 3 miles per hour or 264 feet per minute. A flue of this size, too, will be required to supply 17 horses, 51 pigs, or 77 sheep. Double the number of animals named will require ventilation flues having nearly double the area of cross-section; while for smaller numbers the size should be larger than in proportion to the number of animals to be served, for the reason that in flues of small cross-section there is relatively more friction and the velocity of the air current is less. The most common mistake made is in erecting flues too small. Several small flues are never equal in capacity to a single one of the same total cross-section.

ESSENTIAL FEATURES OF A VENTILATING FLUE.

A good ventilating flue should possess all of the essential features and surroundings which are necessary for a perfect chimney. To produce the strongest draft it must be straight, either round or as nearly square in cross-section as possible, because then the friction is least; the walls must be permanently air-tight, so that no air may enter except from the stable; its top should rise well above the ridge of the roof; and it is best, though not necessary, to place it as near the center of the stable to be served as practicable. It may be placed at one side, at one end, at one corner, or even on the outside, just as chimneys are sometimes, but this should always be avoided if possible. Whenever the length of the ventilator must be unusually short, or it must be placed in an unfavorable position for strong draft, then it should be made enough larger to make good the other defects. Galvanized iron makes the best flue; but double-tongued-and-groove lumber with an acid and water-proof paper between may be used, but the lumber should be well seasoned and unusual care should be exercised by the carpenter in making tight joints everywhere.

The top of the ventilator should be provided with a storm shield. This may be in the form of a simple roof; or it may take the form of some revolving cowl which reinforces the draft as well as forms a shield. When the simple roof is used care should be taken to place it high enough above the end of the shaft, so that there is left an abundant outlet across which the wind may at all times have a free sweep. The old and long used hop-house cowl is an effective form.

At the lower end the ventilating shaft should reach to or near the floor and should be provided with its main inlet for taking up the foul air at the bottom, and the size of this inlet should be nearly equal to the cross-section of the shaft itself. The ventilating shaft should be also provided with an intake just below the ceiling and this should be provided with a door or lid so that it may be partly or completely closed at will. The object of the inlet at the ceiling is to make provision for the escape of the warmest air at the ceiling at times when the stable may be too warm, or at times when there is but little wind movement outside and the drafts may need to be reinforced by the addition of the warmest air of the stable.

INTAKES FOR FRESH AIR FROM OUTSIDE.

It is important, in securing adequate ventilation, that provision be made for the same volume of air to enter the stable as leaves it. Indeed such provision is imperative. Just as it is important that the walls of the ventilating shaft should be tight, admitting no air except at desired points, so is it important that the walls and ceilings of the stables shall be tight, excluding all air except at points where definite provision is made for its entrance. In order that the heat of the animals may be utilized to the best advantage in keeping the stable warm, and because the air is used at the level or near the level of the floor, and further because the waste products of respiration are breathed by the animals to the floor, while the coldest air of the stable is also there, we draw the air out of the stable at the level of the floor. But the body of each animal acts upon the air of the stable, heating it, enabling it to rise to and accumulate at the ceiling where, if it is sufficiently tight, it is retained, heating the ceiling, which then comes to act exactly like a heated radiator sending its warmth back upon the animals upon the floor, thus keeping the stable at a higher temperature than would be possible were the warmed air permitted to escape all at once at the ceiling. Now to utilize the heat accumulated at the ceiling of the stable to the best advantage, the fresh, pure, cold air must be brought in at the level of the ceiling and caused to mingle with it as completely as possible, so as to be warmed by it before it drops to the level where the animals use it. To secure this, provision is made for the fresh air to come into the stable at a considerable number of small openings just under the ceiling on as many sides of the barn as practicable, as represented by the arrows in Fig. 1.

In order to prevent the warm air escaping at the ceiling through these intakes, they must be carried downward by some construction so that the air is forced to enter them at some level on the outside four or more feet below the level on the inside, as represented in Fig. 2. When this construction is adopted it acts on the principle of an air trap, for the warm air of the stable cannot readily pass downward.

A suitable size for these intakes is 4 or 5 inches by 14 or 16 inches, the long axis being horizontal. They should be placed at every 9 to 12 feet along the wall and be provided with lids hinged on the lower edge so as to regulate the amount of air entering the stable, deflecting it upward to the ceiling and causing it to fan out and distribute well through the warm air of the stable. It is particularly important that these fresh air intakes be placed on every side of the stable in order to take advantage of the wind pressure to aid in forcing the ventilation. It is important to recognize that there are three important factors or forces, each of which should be brought into requisition to the fullest extent possible in maintaining the air movement through the stable. These are (1) the wind pressure against the side of the building, which tends to drive air into the stable through any openings on the windward side; this increases the pressure of the air in the stable and so forces it to flow out and up through the ventilating flue. (2) The wind in passing up and along the roof sweeps with increased force across the top of the ventilator, as it does across a chimney, producing an outward suction, thus reinforcing the wind pressure on the side of the building. (3) Whatever rise in temperature the air of the stable experiences, making it warmer than the mean of the air outside, causes the column in the ventilation shaft to be lighter than a corresponding column outside, and hence it is forced upward and out by a force equal to the difference in weight of the columns. There are those who maintain that the last factor is the chief if not the only one which is operative in causing draft in chimneys, and these insist that the air should be admitted to the ventilating flue at the level of the ceiling. The universal daily experience with every properly constructed and placed chimney proves beyond a doubt that the temperature factor is secondary and not primary in producing draft; for always before the fire is lighted there is a strong draft and it increases in strength with the velocity of the wind across the house.

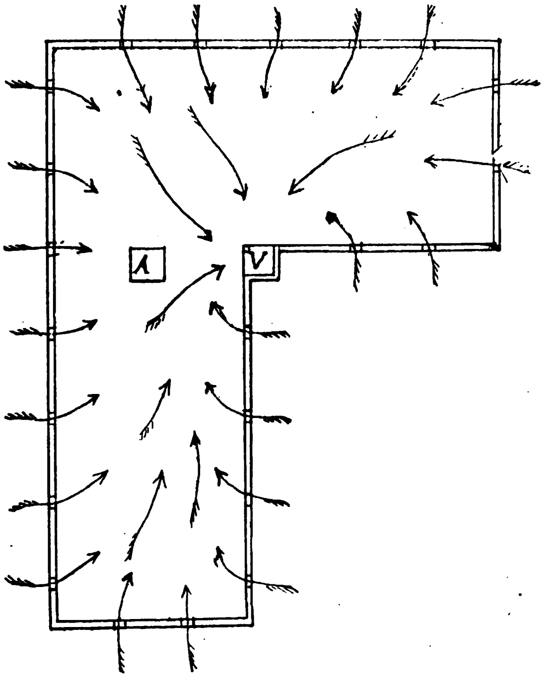


Figure 1.—Showing position of ventilators and fresh air intakes.

In Fig. 1 there is represented the floor plan of a stable where the ventilating shaft is located in the angle outside formed by the wing and the main barn. To secure the strongest action of the ventilator a better position would be at the center, at the point marked A, and if the cows faced out this would be the best place for the shaft, so far as ventilation is concerned. But, usually, the shaft, in such a position, would be so much in the way that it could not be placed in that position. It is usually possible to place it near such a position by sacrificing the stall of one cow.

In Fig. 2 there are represented three methods of taking the air into a stable. At A is shown the simplest method which can be adopted in a frame stable which is sheeted on both sides of the studding. In such cases the air is simply admitted between a pair of studding near the level of the floor on the outside and taken into the stable at the level of the ceiling on the inside as represented at A in Fig. 2. In this case there is represented a lid, hinged on the lower side, intended to regulate the inflow of fresh air when the wind is too strong. In B, Fig. 2, is shown a method of building the intakes into the stone, brick or concrete wall when such material is used in construction. In C, in the same figure, there is shown one method of introducing fresh air into an old basement stable where provision for ventilation was not made for it at the time of building. In this case a wooden box flue or one made of galvanized iron is carried up over the sill and then dropped through the ceiling just inside the wall as shown in the drawing.

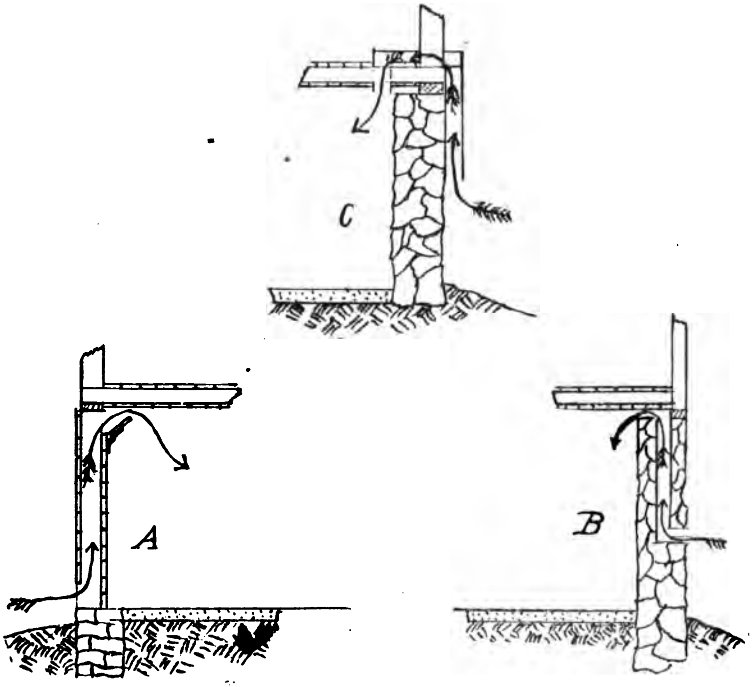


Figure 2.—Showing construction of fresh air intakes.

THE SHORTHORN CATTLE.

(Hon. B. O. Cowan, Chicago, Ill.)

I appear before you this afternoon under considerable embarrassment; not a personal embarrassment so much as the fact that I appear here as the representative of a gentleman who is on your program and whom you have all heard, and who is abundantly able to entertain an audience upon any subject upon which he may speak. I refer to Ex-Senator Harris, formerly of the State of Kansas, who was unable to attend this meeting.

What I shall say will be somewhat at random; I have made no definite preparations. I come then as a volunteer; and while on the subject of volunteers, I remember a story that I heard sometime ago of a revolution that occurred in one of those little republics off the southern coast of the country; and you know that those revolutions in Spanish South America occur almost with every change of the moon; and in consequence of those revolutions, the president of the United States oftentimes has considerable embarrassment in his application of the Monroe Doctrine. At this particular revolution the president of the republic was very much in danger of being overthrown; and the commanding officer of the government forces was surrounded by insurgents and likely to be captured. He sent an urgent telegram to the capitol for reinforcements, and after a delay of what seemed to him an unusual length of time, he received in reply from the commanding officer at the capitol this telegram: "I have this day sent you 180 volunteers by steamer Rio Janeiro. Please return the ropes with which they are tied." And so, as a volunteer, I come with a feeling somewhat akin to that of those volunteers who had been sent to the front to relieve the commanding officer besieged by the insurgents.

It affords me a pleasure, in a sense, to speak in Columbia. For eight or ten years, at an earlier period, I was a member of the Board of Agriculture of Missouri. I was a member of the State Board of Agriculture at the time that your eminent Professor Waters was a student, and he attended practically all the meetings of that State Board here in Columbia. We remember the excellent services he rendered to the State Board at that time and we are all proud of him—proud that he rose from the position of an efficient student to one of the recognized agricultural scientists of America. We think that the University of Missouri is fortunate in the possession of such a scientific agriculturist, and I want to say one word on that point—that at that time and at a prior time the farmers of Missouri, the farmers of the country generally, did not recognize the value of these agricultural schools to the farming and live stock industry of the country. I can remember, as a boy, hearing farmers—and successful farmers and successful stock growers—sneer at your agricultural farming, "book farming," scientific farming; but I am happy to say that has changed. These institutions have been so abundantly equipped with men and means and their work has come up from what in its infancy was necessarily crude, to such an excellent work, that the whole agricultural world today recognizes the agency of these agricultural schools and the value of these scientific agriculturists. I say we owe to them a debt of gratitude and the country generally owes them a debt that it cannot very easily repay. It affords me very great pleasure to give this testimony to men who are doing the work such as is accomplished by Professor Waters and his assistants, and by the general class of men who are doing similar work in other agricultural colleges of our land.

I want to discuss in a general way the live stock industry of the country. I think you will admit that diversified farming is an absolute necessity. We all have recognized that. We were taught that before these agricultural colleges were established. Thoughtful agriculturists long since came to the conclusion that diversified farming was necessary, and yet unfortunately there is a large number of farmers today who have not learned that valuable lesson. I shall not enter into any argument to prove this to you; neither do I think it necessary to take your time to prove that live stock husbandry is absolutely necessary to any well organized and successful system of agriculture. That being admitted, the question naturally comes back to us, "what kind of live stock then will you have?" Why certainly the best kind—certainly improved live stock, because as your lands advance in value, as they rise from what formerly was considered a fair price of ten dollars per acre, up to fifty, sixty, seventy-five and in some localities of Missouri even above the one hundred dollar mark, it becomes absolutely necessary for the possessor of that land to determine the question of maintaining upon it a better class of live stock. You cannot successfully, you cannot economically, you cannot (and keep out of the poor house) maintain upon these valuable acres, these rich and broad acres of Missouri, a class of live stock that brings you a mean, low price upon the markets of the country. Then, I think you will agree with me that it is necessary to have *improved* live stock. Now then, the question of *what kind* of live stock, of course, depends upon the tastes of the man himself, depends, perhaps, somewhat more upon locality, upon his surroundings. But have *improved* live stock; if possible, have purebred live stock. If that is out of the range of your possibilities, then have a class of live stock that is just as near pure bred as is possible for you to possess. This was recognized at an early day in the history of our country. Records show that the importation of improved live stock began at an early date in our country's history. We have a record of the importation of shorthorn cattle as early as the latter part of the 18th century, about the year 1794. There is a record of pure-bred shorthorn cattle being imported from Great

Britain to the United States, and those importations have been kept up with more or less regularity from that time up to the present. There was no great amount of pure-bred cattle imported until possibly the years 1830 up to 1850. During that period, those two decades, there were large and frequent importations of pure-bred cattle, and of course they have had an influence in moulding the character of the cattle of this country. As a result of the shorthorn breed being first that was imported, their influence was stamped, their prepotency was stamped upon the character of the cattle of this country, so that today, if you go over the length and breadth of this land, you will find that the influence of the shorthorn breed greatly predominates. This is not only true of this country, but of other countries. But they were not alone. While they were the pioneers, and while this grand breed of cattle at an early day in this country was brought to a high state of perfection, so that they have from that day to this been held up as the model of what we consider a nearly perfect beef animal, still, I say, they were not alone, because in succeeding times representatives of other beef breeds and representatives of dairy breeds began to find their way into the country; so that at the present time we have a pretty general representation in parts, at least, of the United States, of all the leading beef breeds that are recognized, not only in this country, but in European countries as well. We have the Hereford, the Angus, Galloway, and those breeds that are the offshoots of the Hereford and Shorthorn. And the representative of any breed of cattle, the representative of any breed of horses, the representative of any breed of hogs or any other breed of improved live stock, who seeks to advance the interests of his own by pulling down that which is meritorious as a competitor, is making a serious mistake. We all have our favorites—our reasons for our favorites; and if those reasons will convince the live stock breeders of the country, then we have a right to make converts. If we cannot, by setting forth the merits of the breed we champion, convince our fellow breeders that there is greate merit in this than in some other, then we have no right to seek to obliterate the other by unfair means and by false statements.

In order to show you something of the influence that the Shorthorn breed has upon the whole cattle industry of the country as compared with that of other breeds, I will say that I took the pains, a short time ago, to ascertain the number of registered pure-bred cattle of the various beef breeds. I only consulted the registers of four. I found that the Galloways numbered almost 28,000; the Angus almost 85,000; the Hereford almost 230,000; and the Shorthorns have registered as pure-breds 640,000. In other words, there are three leading beef breeds claiming recognition in this country that are clamoring for the favor of the American public, the complete number of which, according to the record of the various associations, gives a total of a trifle over 340,000. The Shorthorn breed alone has 640,000. In other words, there have been recorded almost twice as many pure-bred shorthorns as all these three beef breeds combined. Now then, we recognize of course that our breed is moulding the cattle of this country in a much larger way than these others possibly can. We have a right to claim that—a right to expect that. The figures of the different records show that; and the very fact that they have been before the American public so much longer a period of time, gives us the claim to superiority at least in numbers, and the record made at the leading live stock shows of the country, the record made on many a hard-fought battle field, convinces us that we have a breed that is not surpassed by any. And the highest compliment that I have ever seen paid to the grand old shorthorn breed is that the advocates of these other beef breeds, during the past forty or fifty years, in this country, have moulded the pattern of their cattle nearer to the type that was established for Shorthorn years ago and then improved by later breeders. I say this is the highest compliment that has been paid to the Shorthorn—that he has been taken as the standard, as the model, as the correct type of beef animal.

We recognize the merit of our competitors, and who would not? Think of the many live stock shows where the championship has gone to their breeds! The advocate of the Shorthorn, who would stand up and claim that his breed possessed all the merit, is a foolish man indeed, because he only places in the hands of his opponent a club with which he himself can be driven from the field. The many live stock shows where the championship has gone to the other breeds show beyond any question of doubt that they possess very great merit. Now, with regard to these championships, many of them have been won by grades. When they are won by pure breds, the successful competitor has a right to claim the entire honor. When they have been won by grades, as in a number of our leading live stock shows, then it is a question of dividing the honors. Of course, if the grade shows the characteristics of one particular breed, the advocates of that breed claim the honors, but in many instances, as we have found by analyzing the blood of those successful competitors, perhaps as much blood of the Shorthorn breed predominates as that of the breed that is claiming the honor and capturing the championship. In other words, the Shorthorn cattle have been in this country so long and their pure-breds and grades have gone out and inoculated (if I may use the term) the common cattle of the country with good blood to such an extent that many of the smaller breeds have taken on the good blood of this grand breed and produced a successful show animal, and then it is brought forth as the champion of that particular breed.

Now, then, I am not trying to rob them of the honor they claim; but I am calling attention to the fact that back of that other blood, and builded upon by that other blood, there was the Shorthorn foundation, and that was a splendid foundation to build upon. We claim that the Shorthorn breed, taking it all in all, is not only the equal but is the superior of the others. It is the equal, it is the superior, as we claim, from the standpoint of a beef animal; and that phase of the question was, I think, most admirably set forth this morning in an interesting paper you heard from Mr. E. B. Mitchell. He showed you what was necessary in order to develop the ideal beef animal; and he impressed upon you that he did not intend by that argument to detract one iota from the claims of the Shorthorn cow as a milk-producing animal; and, in fact, since the discussion that followed that paper this morning, Mr. Mitchell has told me that he thought one of the highest compliments to the shorthorn cow was paid by the fact that representatives of other breeds, who were also trying to produce this ideal beef animal, were using as a nurse cow the old Shorthorn. We claim a dual purpose animal, and I wish to emphasize the position taken by Mr. Mitchell, that if you wish to produce the ideal beef animal, if you wish to bring out a herd that will win the honors in the great contests, it is absolutely necessary that you raise the calf of that cow upon the milk of another. Now, I am not defending this as the best system. As a matter of choice, I would like to see the breeding cattle of the country shown with the calves at side and the cows in milk; and if they all did that, then it would be possible for the man to win who gives the best care to the cattle on hand, providing he had the best to start with; but the man who would attempt to feed a herd of breeding cattle today and maintain the cows in milk, will find when he has come to the show that some other fellow will carry off the ribbons. So that, as a matter of fact, it has resolved itself into a contest of specialties. The man who will develop to the very highest degree possible the beef-producing type of cattle is likely to win the ribbons in case he has chosen wisely at the start. The dairymen, of course, are doing the same thing in the dairy contests. But I say this, it is possible for Shorthorns to maintain a high standard of excellence as beef animals and also make a creditable showing as milk producers.

Last night our friend, Wing, either consciously or unconsciously, paid a high tribute to the Shorthorn cow when he explained the fact that one of his shoulders was lower than the other by the statement that it was made lower by lugging from the barnyard to the dairy those large buckets of milk that were drawn from the old Shorthorn cow.

If I can say one thing this afternoon that will impress upon the farmers here the necessity, the importance, of changing the character of the live stock upon his farm and eliminating the scrub as well as the scrub pure-breds, then I shall not feel that I have talked in vain. I say *scrub pure-breds,* and I say it advisedly, because not every pure-bred animal is good and there is not a herd in the land in which you cannot find a few that ought to be eliminated and sent to the markets if the owner expects to continue to improve that herd and to improve the general character of the breed that he represents. In some herds you will find that there are a very few of this class of scrub pure breds; in other herds you will find, unfortunately, a larger per cent; some of these scrub pure breds are the result of an unfortunate method of handling—by that I mean that the man who has those cattle gives them a treatment that even scrub cattle do not deserve. He sends them out upon a scant pasture in the spring, and they chase back and forth, walking continually to get enough sustenance to merely maintain life. I can find pastures in Missouri, I can find pastures in any state in this country, that are nibbled so close to the ground that a self-respecting goose would not seek to find nourishment in them. That is no method of handling pure-bred cattle—no method of handling any kind of cattle; and the farmer who takes cattle of any kind, no matter how well bred, no matter how well developed, and maintains them for ten generations in that manner, has got, at the end of that time, a herd of scrubs. You can breed feeding qualities into cattle, and you can also starve the feeding qualities out of your cattle, and it has been successfully done by breeders of all kinds of stock all over our land. I am speaking advisedly. I have seen men buy good, well developed representatives of the beef breeds; I have seen the descendants of that same class of cattle ten years from that time, and, gentlemen, you would not know them, and the man who furnished the foundation stock did not desire it to be known that they were offspring of his own splendid herd that he was then maintaining. Now, then, if you expect to maintain good cattle, if you expect to maintain good live stock of any class, you must expect to give them intelligent treatment and reasonable treatment. I want to emphasize by repeating that you can starve the feeding qualities out of any class of live stock, and it ought not to be done, because in doing that you are only taking money out of your own pocket, checking against your bank account. Take the advice of our friend, Wing, and take your calves from their very birth and develop them so as to keep them growing and expanding and developing without any back-set, without any loss of time, why? Simply because it is money in your pocket to handle them in that way; it is an absolute loss to handle them in any other way.

The only way that the live-stock breeders of America can down the scrub is not in trying to down some other breed, but is in a reasonable in a sensible in a manly fashion joining hands in this combat and making a common issue against the scrub of the country, and by this united effort driving him from the fields and from the pastures of the American stockmen.

We cannot hope all to admire the same breed. If I should take this audience to a great picture gallery and there ask you to pass through those rooms, the walls of which were adorned with the handiwork of the best artists of the age, and ask you to point out the picture you thought the best, would you all select the same? Why, certainly not. Some of you would select the landscape scene; some of you would select the mountain views, where the artist has drawn a range of hills, the foothills covered with the rich verdure of the plains, and surmounted by the great snow white peaks that lift their heads and disappear in the clouds; some of you would select that as the acme of the artist's skill. Others would take the picture, probably, that represents the sea coast, where the artist has portrayed the inrolling waves that come driven by the tide and by the wind, and break into spray, and are hurled again upon other incoming waves—and you would point to that as the picture that attracted your attention most. Others perhaps would select the human form or the human face—the picture that represents the beautiful woman; and I will say that a beautiful face—a sweet face—and the form of a woman—a pure woman—is what would appeal to many. And so perhaps you would not agree in the selection of the picture that appealed to you most; and thus it ever will be while we have our fancies, while we have our fads, while we have our reasons for attaching ourselves to this or to that. But let us be united and let us be fair to our opponents. I want to say I honor the successful champions of our opponents, our competitors. I want to say to you in conclusion—you may sing me the sweetest songs that were ever written to commend the champions of these other breeds, and I will respond to the sentiment, I will echo the sentiment; but when you sing those songs I will insist that they be sung in crescendo to the praises of the noble Shorthorn. Go and gather the flowers that have been scattered in the pathway of all these champions of other breeds, and I will take them and place them upon the altar that has been reared to the memory of those departed champions; but at the same time I will go and gather me flowers, I will select the best ones, I will gather me bouquets of American Beauties, of Heliotrope, of Cape Jessamine, and with all the rare flowers I will weave a garland, and with bands of immortelles I will hang it upon the altar that has been reared to the memory of the noblest and the best—the red, white and roan.

GRASS AND FORAGE PLANTS.

(Dr. W. J. Spillman, Agriculturist, Department of Agriculture, Washington, D. C.)

Some three years ago, when the last census figures were published, I found a great deal of valuable data in them concerning the grasses and forage plants of the country. I made a set of maps showing the distribution of them over the country and the production of every grass and forage plant of any kind reported in the census. On these maps I showed the distribution of timothy or of timothy and red clover, because they are usually sown together. After I had made that map I was able to understand one thing I had not understood before. The office of Grass and Forage Plants receives a great many letters from farmers; but to my surprise, when I went to Washington City four years ago, I found that half of the correpondence came from the southern states, and that the other half came from the states west of the State of Missouri. We had practically no correspondence from the region which that map showed to be the timothy region, except that relating to alfalfa. Why? Because in that section of the country the grass problem had been solved by the farmers before the experiment stations were established. Outside of the region of timothy and clover, the grass problem was the leading problem of the farmer. I took occasion, a little later, to go over the experiment station literature on grasses and forage plants, and to my surprise, I found that nine-tenths of the literature that has been published by the experiment stations on these subjects comes from the region outside of the timothy region. For instance, taking up an old bulletin, one of Professor Sanborn's, from Missouri, this was about all he had to say: "Timothy is practically the only hay grass of the State;" the bulletin also stated that blue grass was about the only pasture grass of the State. But from Arkansas, Kansas, Nebraska, Colorado, Louisiana and Tennessee there are stacks of bulletins on these subjects.

Now, for four years past, most of the energy has been devoted to a study of the subject of grasses and forage plants, a study which is of vital importance to the farmers of Missouri. You will be interested to know that the line drawn around the margin of the timothy region showed that that region occupied the whole northeastern quarter of the United States. It cuts off a portion of the southern boundary of this State; it dips down into one or two counties in Arkansas, and in Southern Kansas takes in a tier of two rows of counties, running northward and including three rows in the northern end, cuts off three counties in Nebraska, goes up the Missouri river to Minnesota and turns across Minnesota.

Now the work of my office has been mainly for people outside of this region. About the time I went to Washington City, or perhaps a year or two sooner, the farmers in the timothy region, as well as in all other parts of the United States, began to get interested in the alfalfa plant. Now, I should except alfalfa from the statement which I made about the correspondence that comes to us. We have had more correspondence with farmers for the past four years about alfalfa than about all other subjects put together, and it comes from every state in the Union, and has been coming for five years. That indicates that there is a genuine interest in that subject all over the country. I am glad that you had Mr. Wing to talk to you on alfalfa. I have been on his farm and have seen his alfalfa; he feeds it to his sheep. I have seen corn growing on his land after the alfalfa, and it was certainly looking fine.

The problem in this timothy region then, including this State, in connection with grasses and forage plants (aside from alfalfa, which I will mention later), is not that of the introduction of *new* grasses—it is the problem of better utilizing timothy and red clover and blue grass, and learning how to grow them better.

In my early boyhood down in Lawrence county, Missouri, I remember the farmers were then clearing off the timber and putting in farms. Some of those farms produced pretty good crops. Barnyard manure was not made use of on the old farm where I was raised. I remember that it used to get so deep around the stable door that the horses could not get in and out. But we got very good crops then. I recently purchased a piece of that land down there and am farming it. It used to produce 25 bushels of wheat to the acre, but we consider that it does well now if it produces 12 or 15 bushels to the acre. I remember that in my early day I never heard a farmer talk about the soil becoming exhausted; but now I hear a good deal on this subject down there. Every farmer I meet says, "Will, what can you tell us about commercial fertilizers?" Now, I want to tell you all I know about commercial fertilizers. I have experimented a little and learned a great deal and have talked to a great many farmers about the use of commercial fertilizers, and there is just one thing about them I have learned, and that is this, that barnyard manure is a splendid thing to put on the land, and that is all I know about commercial fertilizers. "But," some farmers say, "it is out of the question for us to put manure on our soils, because we have not got the live stock." "What shall we do then?" The only answer I can make to that is, *get the live stock.* There is no other answer to the question that I know of. I am not saying that commercial fertilizers are not a good thing. I know one state—the state of Georgia—which spent ten millions of dollars this year for commercial fertilizers, and I presume it paid. I don't know whether it did or not. They produce a good deal of cotton down there. The average family of five people who grow cotton on rented land in the state of Georgia has an average yearly income of $80.00. So it must pay. And that is what the people back on the Atlantic Coast are coming to, who are depending upon fertilizers instead of live stock. Now, I have been preaching to the people of the south just what Mr. Cowan has preached here today, just the same sort of sermon over and over again, although I was not particularly championing that magnificent breed of cattle which he represents, but live stock in general. One thing I tell those old playmates of mine in Lawrence county when they talk about commercial fertilizers is, "you have got to get out of the method of farming your fathers used and go to raising more live stock." And they are doing it, too. We have established a rotation on our farm down there for the express purpose of raising feed for live stock, and we are going to see if it can be made to pay. I think there is no doubt about it; in fact, it has already paid for the manure we put on the land.

A short time ago there was a farmer came into my office to talk over this question of commercial fertilizers. I don't know why they come to me, for I don't know a thing about it. After talking with him for a while he saw that he and I did not differ much about the use of fertilizers, and he said, "Well, Mr. Spillman, I have always thought that commercial fertilizers are to the soil just what the lash is to the jaded horse. You put the lash on the horse and he will make speed, but it does not do him any good." I am inclined to think that is what commercial fertilizers do for the soil. I may be wrong. I don't know much about it. Instead of using commercial fertilizers on my own farm, which was all run down when I took hold of it, I am growing alfalfa and red clover, timothy, corn, hay and oats, and feeding every bit of it to stock, and I don't believe I will need any fertilizers; that is not saying I shall not at some time use them; I may find it will pay to do so; but I am depending on other means to build up my soil.

I see some interesting things in my travels of the country. This past summer I was down in Augusta, Georgia. There I found a little group of farmers whose land had been taken by Johnson Grass—that was where it was first introduced—and they had been compelled by necessity to quit growing cotton. They thought they were ruined, and many abandoned their farms. Then some of them went to growing Johnson Grass hay. They are now growing cowpeas, Johnson Grass and Vetch, and nothing but hay has been grown on those farms for sixty years. Well, those farmers are still living in fine mansions in the city of Augusta. When you pass an unusually fine house you ask your companion who lives there, and his reply is, "Oh, he is one of those gentlemen who grow hay." They get $20 per ton for their best hay; that's because the rest of the south are growing cotton. Then I was up in Iowa later—in fact, went right from Augusta up to Clarinda, Iowa. There I rode out among the fields with Henry Wallace, the well known Farm Journal man, when I saw a lot of hay. I said, "What is hay worth here, Mr. Wallace?" "Five dollars a ton," he said. I said, "Why is that? Down in Georgia it is worth $20 a ton, in New York City $15 to $18, in Ohio $10 to $12, and in Iowa only $5 a ton?" "Well," he said, "I will tell you why it is. It is because these fellows out in Iowa have farms that are too good, and they want to get rid of them. They are selling their farms in hay to eastern fellows, and the eastern fellows are building up their farms." Since I have been here I have met a gentleman who is thinking of going back to Virginia and buying some of that land and building it up, a thing demonstrated to be possible. You fellows out here are gradually selling the crops off your farms and ruining your farms, and the eastern fellows are getting rich off of them. This is an unfortunate thing, a great mistake. I tell you, that for the best results, for continued prosperity, in order that you may leave your farm in good condition for your children, you cannot afford to grow hay and sell it for any great length of time; it will exhaust your soil, unless we may learn enough about commercial fertilizers to hold up the fertility of the soil, a thing we don't know yet. I will say this, however that within the past few years we have begun to get some inkling of the proper manner to fertilize the soil; and some general rules are being formulated for applying the fertilizers to a few soil types.

Another matter which is a great source of loss to the Missouri farmer and the farmer of the middle west: the meadows from which you cut hay are being left down too long and allowed to get full of weeds; frequently from 10 to 50 per cent of the hay consists of weeds. And again, when the weather is unpropitious, the hay is often poorly cured. I am confident that leaving the meadows down too long is a source of loss of millions of dollars to the farmers of the middle west. The hay crop of this country is the second crop in value—we had some $670,000,000 worth this past year; but the loss from leaving meadows down and letting them get weedy and the stand get poor costs an enormous amount. A word about the value of timothy hay: A good many people talk against timothy, and if I could not grow clover with it I would not want to grow timothy to feed cattle; but timothy is good feed for horses. There is no equal for it for livery stable horses that are liable to be driven to the limit of endurance just after a full feed, although it is not as nutritious as some other feeds.

I never let a crop of timothy and clover stay down on my farm more than two years. I cannot afford to let my land produce one ton of hay to the acre—neither can you. The average yield of timothy and clover hay in America is 1.1 tons per acre. There is not a farmer in this country who can afford to grow a crop of hay that small, and half of them grow crops smaller than that. By using a proper rotation of crops, and leaving hay down only two years, feeding everything grown on the place, and putting the manure back on the land, you can produce twice that much regularly. That is one of the great mistakes in the management of farms in the middle west. Don't leave your meadows down—I will put it this way—don't leave your timothy and clover meadows down over two years.

There is another suggestion I want to make. There is a better way of sowing timothy and clover than is generally practiced, which is used by some of the very best farmers I have ever seen. The common method is to sow timothy with the wheat in the fall and put clover on that in the spring. You all know that as far west as Missouri you frequently lose your clover from sowing it that way. Now, while it is not always practicable to do any other way, I want to tell you another way that gives a surer stand and grows a little more to the acre. It is the way I did on my own farm the last time with good results. Immediately after taking off the grain crop—wheat or oats, or whatever crop it is—plough the land; then summer-fallow it—harrow it each week until along the latter part of August. Then I sow timothy and clover together; the next year, if conditions are good, you will get a full crop of hay. You are more sure, if you follow that method, to get a good stand. It costs a good deal to put the timothy and clover in that way, so I put them in the old way, but after wheat or oat harvest, if the stand is not satisfactory, I plow again and use the method above outlined and have had good results. I know many farmers who have practiced sowing timothy and clover together after summer fallowing the land with good results. There is one objection to this method: it is so dry sometimes in the fall that you cannot get any moisture to sprout your seeds. But if you will plow immediately after harvest (you will usually have a rain that will enable you to plow during July), and then harrow once a week right straight along, you can get a stand of grass in the fall. It is expensive, but a sure way of getting a stand. I find it is profitable; I am not bothered with weeds, and get a good deal of hay. In plowing in the spring and summer, and particularly when plowing for summer fallowing, it is of the utmost importance that you follow the plow immediately with the harrow. When you plow a half day, then harrow immediately all that has been plowed that half day. If you will harrow every half day up to the plow—and after that harrow every week or ten days—you can keep the land in condition to sow your seeds any time you want to.

I shall now tell you of something that ought to be of interest to you men. Down in Tennessee, during recent years. a disease has broken out that absolutely exterminates the clover crop within three weeks after it begins. It is a fungus disease, and prevails over a large section of Central Tennessee. Whether it will spread this way or not, I don't know; I hope it will not. I should hate to see red clover exterminated from the State of Missouri, but it is being done rapidly in the state of Tennessee. There is apparently the same disease in Western Oregon in the Willamette valley, one of the finest red clover regions on the American continent. That disease is exterminating red clover in that valley. I would advise you gentlemen to be very careful about using soil from distant sources for inoculating purposes. We have been in the habit, in sowing alfalfa particularly, of inoculating our land by getting soil from other places. Be very careful not to get soil that has this clover disease in it. The disease attacks both clover and alfalfa. But it will be of interest to you to know how farmers are meeting this disease. The two localities where the disease is prevalent are each solving the problem in its own way.

In Tennessee alsike clover is being sown on thousands of acres. and it is immune to the disease. In that state red clover is being replaced by alsike. In Oregon the farmers have solved the problem in a different way: the common vetch, the tare mentioned in the Bible, is taking the place of clover in that country. It yields more and better hay than clover—the highest priced hay in the United States is vetch hay. These facts will be of interest to you if you get that red clover disease. My advice is to experiment on a small scale with vetch, so that if you need to use it you can. It would be well for the Experiment Station to take up this matter and be ahead of the farmer and see what can be done with these crops.

I will not talk to you much about blue-grass, because I know that Dr. Waters is a better authority on that subject than I am. I want to mention a few other grasses very briefly.

Orchard Grass.—To the farmers of Missouri this grass is, generally speaking, of no interest; but there are parts of the southern section of this State where it would do well. Wherever timothy will thrive I would sow it, but where it does not thrive then orchard grass is the next best hay grass. It is a good grass if handled right, but requires more intelligent management than timothy does. It must be cut promptly when ready to cut or the hay will be very inferior.

Meadow Fescue.—This grass is attracting attention in Eastern Kansas; driving out orchard grass and timothy. It is being planted on a large scale out there. It is invading Western Missouri; it may prove to be of importance to you. They are growing it in the southwestern portion of this State. In parts of Kansas they consider it the best grass they have. It might pay you to experiment with it; but you should do so on a small scale until you know what it will do and how to grow it.

Brome Grass.—In the southern half of Missouri this grass will not thrive at all; but in the northern part of the State it will grow and thrive. In my judgment, this is the best pasture grass in the northern half of the United States. It is fully as palatable as Kentucky bluegrass, and yields more. It is somewhat difficult to eradicate as you go farther east. In Nebraska and Dakota there is no difficulty in eradicating it. It is to the Dakotas what timothy is to Missouri.

I had hoped to be able to talk a little here today on the subject of "Farm Management," but I can only touch on the subject in a general way. I will only stop to say this: That when I went to Washington City, four years ago, I began to attempt to make the work of the office of Grass and Forage Plants one of intense interest to the farmer. I had found by experience in the state of Washington that I could learn more in one month by going out and questioning the farmer, going out on the farm and studying the farmer and his methods and results, not always accepting the farmer's conclusions, but seeing for myself the results he was getting and learning how he got those results—I say I found I could learn more in one month in that way than I could learn in a whole year on the experiment grounds at the Experiment Station. But I found, too, that there were some things I could not learn from the farmer. I heard a farmer say the other day—a very intelligent farmer—in a talk at a big meeting in Tennessee, that he had planted a crop the second time on the same land and some kind of a fungus disease had injured it; then he turned around and said to Director Morgan of the Experiment Station: "Professor, there is a problem we cannot solve, and we must call on you for help." So I say there are a lot of problems which farmers cannot solve and must call on the Stations to solve them. But the farmers have already solved many important problems. My office, last July, was converted into the office of Farm Management. It is a part of our work now to study the farmer and what the farmer has accomplished.

It is the chief function of the office of Farm Management to convey to the farmers the results of scientific teaching, results obtained by the Experiment Stations; and whenever we are sure of a certain result, when we are sure a certain thing is a good thing in any part of the country, we go and try to persuade the farmer to make use of it on his own farm, and we help him out as far as we can in applying it. That is, in very brief outline, the work of the office of Farm Management. Down in the cotton states there is no difficulty in teaching farmers how to do better. We have established thirty-five farms down there—object lesson farms. We are running those farms in conjunction with the experiment stations to show the farmers they can do something besides grow cotton. Our work in demonstrating improved methods of farming has very largely been a success in that section of the country where the poverty is the most extreme, where they need our help the most, and are calling loudly for help from any source they can get it. The average family income from cotton is being cut down one-half, from $80 to $40, by the boll weevil; and we are trying to help the farmers to improve their condition, to get out from under the tryanny of old King Cotton. I wish I had time to tell you more about the work this office is doing.

Twenty years ago next June I graduated from this institution. I was a very proud boy that day; but soon after that I was called out of the State, and this is the first time I have ever had the privilege of addressing an audience of Missouri farmers; I appreciate it more than I can tell you. I am one of you, was born and raised and educated in your midst, and you can imagine the gratification with which I come here and see this magnificent Department of Agriculture developing in this great University. The University is already known better for its Department of Agriculture, perhaps, than anything else, because it is the thing the papers write most about. The farmers of the country are getting interested in agricultural colleges, and they are appropriating money to build up one of the greatest institutions of the kind here in the State of Missouri, whose object it is to study the needs of the farmers of the State.

THE OUTLOOK FOR THORIUGHBRED DAIRY CATTLE IN MISSOURI.

(Dr. Geo. O. Mosher, Kansas City, Mo.)

The outlook for thoroughbred dairy cattle in Missouri was never better than at present. Our great State is just waking up to its possibilities, not only in agriculture generally, but more in the matter of dairying, which, from a bare side issue of general farming, has taken a position which ranks with any of the special agricultural industries of the State.

When we consider that Missouri annually sends out of the State two million dollars for dairy products, there is no need for surprise as to the rapid development of dairy farming in this State.

Our orators all tell us that Missouri is an empire in herself. In no other element does she assert her imperial majesty more than in her agricultural resources. She has the conditions, as Professor Waters says, for making one of the greatest dairy states in the Union.

This industry is now only in its infancy. The young men who are taking up the scientific dairy course, under Professor Eckles at the State University, will find ready employment as dairy herdsmen at good wages. Our farmers are no longer satisfied to breed their dairy cows to any scrub bull which happens to be in the neighborhood, but, realizing that the bull is half the herd, they are demanding for their dairy cows the service of bulls, not only good individuals, but of rich ancestry as well. Consequently, the outlook for thoroughbred dairy cattle in our State never was better.

I am well aware of the conditions prevailing in the other fine herds of which Missouri can boast, and the universal answer to the question as to the demand for good dairy stock, there is not sufficient to fill the orders; consequently our breeders are looking forward to a prosperous year.

It is a source of gratification to those of us who have been engaged in building up this industry, the breeding of better cattle, to realize that our efforts are being appreciated.

In the next five years, it may be safely predicted, that Missouri will not only be able, by building up her dairy herds as she is at present, to supply the demand of our own citizens for dairy products, but to have for export an equal amount, which being stamped "from Missouri," will command the best prices in the market.

Our Missouri dairy cattle at the World's Fair were in the front rank all along the line. We are constantly increasing our shipments of young stock bred in Missouri to build up the dairy type in our neighboring states, consequently it can be asserted that the outlook for the dairy breeds was never brighter than at present.

THE STANDARD BRED TROTTER.

(Hon. Norman J. Colman, St. Louis, Mo.)

I don't know but I ought to say, in introducing myself, as most of the gentlemen who have spoken before me have done, that I was born upon a farm and had to work as hard as any of you. I don't except any, because my father was a hustler and his two sons had to get up and work with the hired men from early to late, and when the work was done we had to come in and milk the cows and do the chores. I thought it was a pretty hard life. I thank God that I was born on a farm, and had to work and develop a sturdy constitution, with which I have been able to fight the battles of life. If I had been brought up in a city or town I have no doubt I would have been dead years ago; but I strengthened my muscle, and developed a constitution by working upon a farm, which has aided me in the great battle of life; and it has been truly said that you can scarcely mention a man who has distinguished himself in any walk of life who was not born upon a farm. You must have a sound mind in a sound body—in a vigorous body—and the only way that can be accomplished is by developing the physical system.

I received an invitation to talk to you about the Standard Bred Trotter. I regret to say that I have not devoted a single minute to the preparation of an address—I do not think I have ever been so derelict in my life—and instead of an address it will simply be a talk—an offhand talk, perhaps somewhat scattering. It is true I feel at home in discussing this subject. I inherited a love of the horse and I have never been able to shake it off, and I am glad I have not been, because I think I would have been dead long ago if I had not had something of this kind to interest me in outdoor life.

I do not wish to antagonize any other breed when I speak of trotting bred horse. There are certain fields for other classes of horses. I have no doubt that there are present those who believe that the draft horse is the only horse to breed, and perhaps, those who believe that the imported Hackney or French or German Coach horse is the proper horse to breed, and others that the saddle horse is the proper horse to breed, and I say I do not wish to antagonize any of them.

Missouri is a great State. It is capable of producing all classes of horses, and I say "God-speed" to every man who can breed any of these classes profitably. If he finds there is a demand for them, it is not only to his interest but it is his duty to endeavor to fill the demand. We need to pay more attention to the breeding, not only of horses of all classes, but of mules. Missouri is a natural stock growing State. There is no state whose grasses are more nutritious, whose waters are purer, no state that can produce a higher type of all kinds of stock than Missouri, and the preservation of our farms, of our agriculture, depends upon live stock breeding. I wish I could impress this on your minds so strongly that you would go home and preach this gospel to everyone—that the cultivation of our farms in cereals, in the production of grains, and marketing the crops, which are so produced, is sure to bring ruin eventually to those farms, as it has done in all the older states of the Union, as it has done in Europe and throughout all nations of the world, which are now buying the cream of our soil in order to raise profitably any sort of crops.

A few years ago I visited Europe. I had at that time served a term at the head of the Department of Agriculture in this country. Through the London papers, Sir John Laws of the Rothemstead Experiment Station saw that I was there; he invited me to become his guest and to visit his experiment station, which invitation I accepted. About the first thing he did was to take me to his library and show me the reports which had been published by the Agricultural Department of the United States, saying: "I know you just as well as your own people do," and then he gave me a very severe lecture. He said: "Your people are selling off the cream of their farms to us Europeans." He took me to his stables. "Here," he says, "is cottonseed meal and linseed meal, the cream of the land of your country. I am buying it; English, Scotch, German and French farmers are purchasing it and are getting just double what they pay for it, notwithstanding the freight from your country here. We feed it to our stock and get compensation in the growth of our animals, and when we distribute the manure over our farms we again get back our purchase money." He said: "You are bringing ruin upon your country, and if I were an American I would insist upon having a law passed to prevent the exportation of the very cream and fertility of the soil." He showed me some of the fertilizers, the phosphates, which he was buying from this country, and he said by and by this will be exhausted, and you in America will be in the same condition that we are here in Europe.

I refer to this as an illustration to show that we are causing the ruination of our farms when we sell off our crops; we are selling the out and weaned in the spring. They have the green herbage to feed upon and are no trouble to wean. I think every farmer should keep a half dozen mares, because if you raise the right quality of horses there is always a demand for them. It costs no more to raise them than it does to raise steers, and they will bring double, treble and sometimes quadruple the price if of the right quality. I have 80 head now on my farm. Horses are no more trouble to raise than so many sheep, if you have got pasturage for them. It is true I have got a never-failing stream of water running through the center of my farm, so that I am not compelled to water them; and I want to tell you that a good stream of water, fed by springs that run continually during the year, is a most valuable feature on a farm. Every stock-breeder knows that--he does not have to depend on wind mills or gasoline engines, or anything else. The price of standard bred horses is very satisfactory always if they are of the proper quality. How many of them, even those raised by farmers, have brought several thousand dollars each? If a farmer has been able to raise one of these he has got a mortgage lifter or a good sum of money to deposit in the bank. I don't advocate that all farmers should breed this stock; but they should if they have an aptitude for it, and don't want to go into it for gambling purposes (and most of them do not). You can use the colts on the farm when they are about two or three years old; if you want to run little errands, you can drive them, and in that way you are developing them; and if they show any unusual action, or speed, or style, there is always some sharp man who keeps his eye on them and will pay good prices for them; and men like good horses. Our fairs are not successful unless we have the attraction of races. Man was created to admire, next to a beautiful woman, a beautiful horse. Kentucky is noted for its beautiful women and magnificent horses, and you will never find a Kentuckian whose admiration doesn't turn in that direction, and people from other states are much like Kentuckians in that respect.

In raising horses, it is just like raising any other kind of stock; the young stock especially should have good care and good treatment; they should be housed in the winter, especially over night; they should have good feed. I have found no forage that produces so much growth in the young animal as alfalfa hay; it is an indispensable thing to have on every farm; you must raise alfalfa and cow peas or some other leguminous crop if you would keep up the fertility of your land; if you would raise good crops of corn, you must raise alfalfa, clover or some such crop. I think we are coming to the point where every farmer can raise alfalfa. If it can be raised so successfully on the white clay soils of Ohio, where the crawfish flourish, how much more successful should a crop of it be here in Missouri? The thing is to start out and sow it. It is not simply a good horse feed, it is a good cattle feed; it is a good sheep feed, and above all, it is a good hog feed. There are farmers in Kansas who don't give their hogs an ear of corn, but send them off to market as shoats weighing 200 to 250 pounds, having been fed on alfalfa fields; but of course a few ears of corn, thrown out daily, would be of great advantage to them. We have been neglecting one of the most important crops ever since our State has been a state—the alfalfa crop. In Europe it is called Lucern. I saw it in large fields upon the Rothemstead experiment station farm in England, saw it in Germany, and in France, in Belgium, Holland and Scotland. It is considered there an indispensable crop to the farmer; it is there fed to dairy cows; fed to everything, and if it can be produced there, it can certainly be produced here in Missouri, where Heaven has given us such bounteous soil and glorious climate; and if I can make an impression upon every farmer here to try it, to get the best seed, to give it a fair trial, I will have accomplished something.

If you are afflicted with crab grass or fox tail on your farm you must keep it cut down or it will smother out the alfalfa the first year or two. I think alfalfa should be sown about the first of August—after a good rain, if possible, so as to have plenty of moisture. By sowing it then you will avoid the crab grass. Harrow the ground smoothly, sow the seed, and if the ground is not too moist, run a roller over it to compact the soil about the seed. I use a fluted roller—not smooth, but corrugated; manufactured in St. Louis; those who have used it are much pleased with it. I use it on everything I sow—oats, alfalfa and even on corn after planting.

The great trouble is if you leave the soil too porous there will be too much evaporation of moisture. You must compact it pretty firmly around the seed. My superintendent did not believe much in this rolling; I had quite a large field to sow in clover, and he decided to try an experiment, thinking I would not know it. He left a gap of an acre or two that he did not roll after sowing clover and oats; and when he was harvesting the oats I went over the field with him, and saw that place he had not rolled, and I said, "What under the heaven is the matter here?" There was a strip with only now and then a stalk of clover. He "fessed" up. He said, "I did not think it was of any use to use the roller, and just thought I would try an experiment. I see I made a big mistake. Where the seed was pressed down firm and compact the results are good, but where I neglected to do this I see the results in this bare strip here."

The only way you can return the mineral elements to the soil is to buy them. You have got to buy your potash, your phosphate, that you extract from the soil in every crop you produce. I want to say in reference to the purchase of fertilizers, that in my opinion where your soils are beginning, as they are on every farm where crops have been taken off to produce less and less, owing to the diminishing of the plant food in the soil, that I favor using some fertilizer. I have found, by experience, that ground rock phosphate is the best fertilizer that can be employed on my farm. It is a mineral element; you cannot get it from the air nor through any plant. You have got to go down to Tennessee or Florida to those phosphate deposits. I was down in Florida last winter, and I am sorry to say that Germany has bought up an immense deposit of this mineral element and is cutting a channel right through the reefs for a mile or two to reach this rock phosphate bed, and it is being shipped by the ship load over to that country. When all our phosphate beds are exhausted, what are we going to do for mineral fertilizers? So, gentlemen, it behooves us to preserve what we have got of the mineral elements, which we cannot extract from the air as we can nitrogen by growing cowpeas, alfalfa or clover, or some other leguminous crop. That is a point I am anxious to impress upon every farmer here. That is why I urge dairying; that is why I urge stock-raising of all kinds; feeding everything upon your farm and returning the fertility taken from it to the soil; and not exhausting the soil and leaving it worn out, as has been done in Virginia, or Maryland, or the New England or southern states. We must not wear out our soil here in that way; we must not be so selfish as to get every dollar we can out of the farm and leave it bankrupt; if we do, what will become of our posterity?

I might talk to you a great deal more about raising horses and raising colts, about breeding them. The great law is, as I have stated, that like produces like or the likeness of some ancestor. There is a great deal in that "some ancestor." That is why pedigree is essential. Sometimes an animal will be produced like an ancestor which existed four, five, six or even ten generations back. I have known of horses that have been marked like their ancestors six generations ott, even to glass eyes, when none of their progeny had been marked in this way before. This law of breeding is a most mysterious law—hence, you want pedigree. You want to know the history of the generation preceding the animal which you breed from. You want to be very careful. If you are going to marry you are careful. You study the history of the family with which you are going to unite. You want to know whether the men have been of good character, and whether the women have been of good character; whether there has been any weakness in the family. Another thing that we don't pay enough attention to, and that is, we want good mothers, good dams, of all kinds of stock. You have never seen a great man that did not have a good mother, a mother of ability, in some lines, either natural or acquired; and these young men, who have not married, should bear in mind that if they want their children to be an honor to them they want to marry women with good minds and good morals and good ancestors and good physical development. Everything depends upon a good mother—every farmer knows that. I know it from the breeding of horses for the past forty years.

THE DEMAND FOR CAVALRY HORSES.

(John S. Bratton, dealer of horses and mules, National Stock Yards, Ill.)

There is one class of horses that Missouri is particularly adapted to produce; that is the cavalry horse or trooper. There never was a time in the history of the United States that the government was in more need of remounts than it is at the present.

There was a contract let in Washington, January 10, for five hundred mares or geldings, to be shipped to the Philippine Islands for cavalry purposes.

Missouri Well Adapted to Raising Cavalry Horses.—There is no state in the Union that these horses can be bred to as good an advantage than in the State of Missouri. The horse breeders of Missouri are inclined to lean towards the light horse, and particularly to the riding type. A great many thoroughbred stallions are scattered throughout the State of Missouri. It has been demonstrated by the older governments, especially by England, that a cavalry horse must have a certain amount of thoroughbred blood in order to be able to stand the long marches and to carry the weight of a soldier with his marching outfit. There is no doubt but what the thoroughbred imparts to his off-spring that wonderful stamina that enables him to make longer marches without food than any other breed. The thoroughbred sire is entirely too much neglected in this country. One reason I attribute this to is because he is obtainable so cheap. A good thoroughbred stallion can be bought for $150.00 to $250.00; and when bred to the common farm mares of Missouri he will produce good troop horses, what the government is now looking for, for which the producer can receive as a four-year-old from $125.00 to $150.00. In breeding this way it will be found that a great many good hunters and park hacks will also be produced.

Ireland for a great many years has been recognized the world over as the home of the hunter, the officer's charger, the troop horse and the hack. It is very hard to breed a perfect type of a hunter. In Ireland they have never been able to establish a Hunter Stud Book. The very best hunters, that have brought enormous prices in England, France, Germany and Belgium, have been by thoroughbred stallions out of common farm mares.

They have in England now what is known as the Hunters' Improved Society, which has in view the following object: First, to give prizes to breeders of hunters and horses used for riding and military purposes; second, to give premiums in shows for thoroughbred sires suitable to get hunters, good riding horses and horses suitable for military purposes, and also to give prizes for mares suitable to breed to thoroughbred stallions in order to produce hunters, riding horses and horses suitable for military purposes.

A mare bred to a thoroughbred stallion to produce the above results should stand 15 to 15-3 hands high, with good shoulders, good back and quarters, with as much length of neck as you can possibly find and a good head. You need not be so very particular about the neck, shoulders and head if you have a good sound, short-legged animal, as the thoroughbred sire will give to his offspring the length of neck, the shapely head, sloping shoulders, short back and the weight carrying abilities that no other sire is capable of doing.

In order to get a good riding horse you must first look to the shoulders and back. A horse with straight shoulders will never give a comfortable ride, he is greatly inclined to stumble.

The Thoroughbred a Good Tempered Horse.—A great deal has been said against the thoroughbred as a hunter and park hack, and I might also add, as remounts for cavalry, on account of his hot temper. It is a well known fact that most thoroughbreds that are used for racing purposes are put in training in their yearling form. They are schooled to the barrier when babies. The trainer stands behind the bunch of yearlings with a big bull whip, and if any of them is slow in getting away when the barrier is sprung, he not only feels the weight of the whip, but is almost scared to death by the crack of same. In this way their tempers are broken to a certain extent, and it is an utter impossibility to expect youngsters bred like they are to stand quietly when they are lined up with other horses, as they are very seldom asked to do so until they are four or five years old, and then only when they are not good enough to win races, or when they have been broken down.

You must not draw your conclusions from what you have seen at the race tracks as regards the thoroughbred type, as the horses that you have seen go to the barrier are trained so fine that they are nothing but bone and muscle. You might, for instance, draw your conclusions if you have ever seen a trotting horse in training and have seen the same horse when he has been handled for heavy harness purposes, after his tail has been set up and he has been docked and put in show condition, with the addition of, at least, from two to three hundred pounds of flesh. Scarcely a man on earth would recognize him as the same horse that was hitched before a sulky.

I showed four standard bred trotting horses at the New York horse show last fall, and a great many of my friends could not believe but what they were imported coach horses until they had seen them step. In like manner, when the thoroughbred horse is used for other than racing purposes, and put in condition for hunting or riding, he is an entirely different individual, and comes more on the type of the gaited saddle horse with that conformation that is impossible to get from any other source only through the thoroughbred sire. You will find that you have at the foundation of your saddle horse family thoroughbred blood, and the nearer you get to the thoroughbred the better riding conformation you obtain.

Do not forget that Aaron Pennington (a thoroughbred stallion) helped to establish the saddle horse family in Missouri, and was also the sire of several on the trotting track with records better than 2:30; among them "Harry Pennington," with a record of 2:15¼. Can you take any other breed and do this? "Aaron Pennington" not only sired race horses on the running turf, but he sired race horses on the trotting turf, and also sired show ring winners, and the dam of show ring winners for your gaited saddle horse family.

I saw a thoroughbred horse win the saddle class and championship at the Madison Square Garden, New York, last November. He was a three-year old, but had never been trained for the track. He was the best tempered horse I have seen in a great many years. I am perfectly satisfied that nearly all thoroughbreds would have just as good tempers as he had if they did not have to go through the course of training that enables them to break away and get to running fast from the starting barrier.

I would further say, in this regard, that there are over forty hunt clubs around New York City, and I believe over thirty around Philadelphia, with several at Boston, Chicago, Pittsburg, and, in fact, all the leading cities today in the East and middle West. At each of these hunt clubs there are at least several hundred hunters. I know of several gentlemen who keep from twenty to thirty hunters for their own private use at these different clubs. A great many of these hunters have been imported from Ireland. Mr. Mather, the late master of the Radnor Hunt Club at Philadelphia, has all imported Irish hunters. I believe he has in his private stables at present about twenty-five.

Missouri the State to Breed Hunters.—Ireland has ceased to produce the hunter of old, and they are looking to America to fill that place, and Missouri is the State that should take the foremost rank, as they have the best foundation to breed hunters, on the dam side, of any State in the Union.

I see in my sales, week after week, some beautifully shaped Missouri bred mares that would make the very best dams to produce hunters and cavalry horses, that it is possible to procure.

The landlords in Ireland all owned large racing stables. A great many of them raced in England and on the Continent, and a great many raced in Ireland. When one of the thoroughbred stallions broke down he was generally stood at a very small fee in some part of the estate, and, in some cases, no fee at all, to be bred to the farmers' mares. The result of this union was the Irish hunter and Irish cavalry horse, or officer's charger, which the country for a great many years had been noted for. Along came the land agitation and the landlords were either driven from Ireland, or the land bill compelled them to reduce their rents, and in a great many cases, also gave the tenant the right of purchasing. With them went the thoroughbred sire. In his place the English government has introduced the Coach horse and the Hackney, and the results are at the present time that we are deprived of the good Irish hunters and cavalry horses that Ireland has been famous for producing.

I would like to see the Missouri breeders breed thoroughbred stallions to their farm mares, and produce what we are now greatly in need of, and what we will need more and more every year in the future, viz.: horses typical for military purposes, for the hunting field and for pleasure riding.

If you breed a standard-bred trotting horse to a common farm mare you will hardly expect to get a two-minute trotter. If you breed your beautiful Missouri bred gaited saddle horse to a common farm mare, you will hardly expect to get a Rex McDonald. In order to get a high-class gaited saddle horse you have to cross your gaited saddle stallion to your gaited saddle mare, and in order to get a two-minute trotter you have to breed your trotting stallion to your standard bred mare, but in order to get what we now need, breed your common farm mares to thoroughbred stallions, and you will get the quality in the offspring that your farm mare cannot produce bred to any other sire.

At the New York horse show they gave a prize of $500.00 for the best thoroughbred stallion suitable to get hunters. I would like to see the different fair associations in Missouri give suitable prizes for the best thoroughbred stallion to get hunters, riding horses and horses suitable for military purposes.

Suggestions to Breeders.—In breeding, be careful and never breed to a roarer; it is very hereditary. Be very careful also to never breed a mare that has been foundered. Try to select mares that are free from any hereditary unsoundness, such as spavins, ring-bones, side-bones, or moon blindness. If your mare is deficient in any point, be sure and pick out a stallion that is proficient in the same point; for instance, if you have a mare that is a little bad in the withers, pick a stallion that is very prominent in the withers. If your mare is coarse in the head, be sure and pick a stallion with a very neat, small head. If she is short in the neck, look around until you find a stallion with a good, long neck. It is very hard to get brood mares that are proficient in all points, but this can be overcome by being careful to select a stallion that is very prominent in the parts that the mare is deficient.

I want the breeders and farmers to thoroughly understand that while I champion the thoroughbred so strongly as a sire, I am not throwing "cold water" on any other breed, as I think the American trotter is the grandest horse today in the world. I have won more prizes in the show ring with American trotting bred horses than any man in this country. I sent the American trotting bred horse, "Governor Brown," to England, and won seven blue ribbons and the championship for best heavy harness horse at the Crystal Palace show, London.

Missouri Honored.—Missouri ought to be proud that she has produced one of the best heavy harness horses I have ever had the pleasure to ride behind. He was bred by Governor Colman of St. Louis, a member of the Board of Agriculture. He is now owned by Thomas Lawson of Boston, and has been picked out by the United States government and by other governments as the best type of heavy harness horse to be found.

The Horses the Market Demands.—The class of horse that I particularly want to draw to the attention of Missouri breeders and farmers is a class that has never been produced in this country unless by accident. When you come to think that a good hunter will bring all the way from $1,500.00 to $2,500.00 in New York City, and that a medium hunter will bring from $700.00 to $1,200.00, and a common hunter from $400.00 to $700.00, it is surely time that some steps be taken to produce this class of horse.

The dealers in walk, trot and canter saddle horses in the east at present are scouring all over the western country to find material for their trade in the east, bred on the lines that I recommend. During last year Mr. Charles Halloway of New York purchased several horses in the State of Missouri that were sired by thoroughbred stallions out of common mares, and when put in the proper shape, were winners in their respective classes at the different shows in the east.

Not only are these horses desired for the hunting field and pleasure riding, but they are the very best material for road fours and for all kinds of work in heavy harness where endurance is required. You take a horse of this type, when he has action, and he will command the very highest price for a harness horse.

One other thing that I neglected to mention is that a great many people think that the thoroughbred horse is a stiff-legged animal with no action. This is a great mistake. The shoes that are used on thoroughbred horses from their babyhood do not weigh more than an ounce and a half, and it is a well-known fact among harness horsemen that extra weight of the feet develops and strengthens the muscles that control the action; therefore, I claim that I know from practical experience that thoroughbreds that have been shod in the regular way from their two and three-year-old form have as much action as an ordinary horse.

I own at present a horse by a thoroughbred stallion out of a trotting mare that can go very high and fast. I expect to win with him in heavy harness classes. His conformation is very much better than any horse I have ever owned, and I attribute that to the strong infusion of thoroughbred blood that flows in his veins.

A great many thin horses, both on the draft and driving order, come to market. The breeder or farmer makes a great mistake in not taking more care of their horses before they put them on sale. There are not less than fifty feeding stables around the National stock yards, East St. Louis, Illinois, that are buying these horses, putting them in the feeding pens and feeding them for at least 150 per cent more expense than they can be fed in the country. They have to do this in order to make them marketable in the eastern cities, where they are sold. If the breeders and farmers were to pay a little more attention to these horses, keep them sheltered in the severe weather, and put more flesh on them, they would receive the benefit that the middle man, or feeder, is now deriving.

A man who feeds horses at our yards has to pay a great deal more for his feed; he has to pay a big rent for his barn, and from $12.00 to $15.00 a week for men to look after them. Still he can make a good profit by feeding. At the same time, it is well known that he has a great many of these horses who take sick with distemper and go wrong in the wind, when they have to be sold for a loss. This very seldom, or ever, occurs where horses are fed where they are raised.

Farmers and breeders should pay particular attention to this point, as week after week I sell horses that are in no fit condition to come to market, and afterwards sell the same horses for $40.00 to $50.00 per head more, when they have been fed here about thirty or forty days.

Put your horses up. Feed them well for at least a month before you expect to sell them, and shippers will be only too glad to pay you several times over for your trouble in doing this.

See that your foals get plenty of care in their yearling form, and they will show you afterwards that you are well repaid for all your extra feed and trouble during that time.

BABY BEEF.

(Hon. Joseph E. Wing, Mechanicsburg, Ohio.)

It is really an interesting thing—this feeding of the babies on the farm. When I was a boy we used to let the babies grow up before we ever fed them. We thought the animal had to have his life divided up into two parts—in one part he got his growth and in the next part we fed him. Don't you remember that? Why, we never dreamed of having to feed the babies. We never dreamed of feeding cattle until they were three years old, and we thought the sheep had to be three years old, too, before we fed them, and the pigs, too. We have gotten over that now. The pigs in our country seldom get to be over ten months old—they go to market while babies. The lambs go to market before they are one year old. Almost all the sheep in the United States go to market before they are one year old; and the steers, the poor little baby steers, also have to lose their happy lives while young.

In the corn belt, where land is worth $100 an acre, men who keep cattle are almost compelled to keep the kind that pay to milk, so you can save the milk and make it into butter and cheese. I believe you have always got to do it, and then when you begin to decide what kind of cows you will keep you turn it over in your mind and decide that you want the cow that will not only give plenty of milk, but whose calf will grow into a good beef animal. By the way, do you know what made one of my shoulders lower than the other? It was carrying buckets of milk on that arm that came from an old Shorthorn cow. The trouble was my father was so kind-hearted he would never allow me to carry but one bucket at a time. If he had let me carry two buckets at the same time, why, I would not have been so lop-sided; and that very fact has caused me to have a serious leaning toward the dual purpose cow. I have taken care of those cows and know their whole history.

Let's tell the truth now. There are dual purpose cows. There will be vastly more. You are going to milk them on your farm. You are bound to do it on this high-priced land. We have got to get the most income from our land. How are we going to get calves from those cows and make the most money? In the first place, they ought to be born in the fall. When they are born you must let it run with its mother a little while, but not too long. One day is long enough. Don't let it run with her a week. Why not? In the back of the little calf's neck there is a spring, and every day that that calf runs with its mother that spring gets bigger and bigger; and after he has run with his mother for a few days take him out and teach him to drink. He comes up to the bucket of milk and you take him by both ears and you pull and push, and by the time you get his little nose up to the milk you have got his hind feet off the ground. Now, that's not the way to do. You must make him think you are his mother. Wet your finger with the milk and let him taste it, and then make him follow your finger until he gets his nose in the milk. I have taught a thousand of them to drink, and it is no trouble if you go at him right. He must have the mother's whole milk for quite awhile—for about a week or ten days he must have the mother's whole milk, and very gradually reduce to skimmed milk, and you will find that he will hardly notice the change at all. You will need a cream hand separator to separate the milk as quickly as possible after milking, before it gets germs in it. And I will say to the boys that the daughters of the house are turning the hand separators. That means that that is going to make a new race of husbands in this country, because those girls are developing wonderful muscle.

Well, when you separate that milk and give the skim milk to those little calves, they think it is just as good as the milk they get from their mothers—almost. It is true that you have taken something out of it, and so you must put something back in place of what has been taken out. I am not sure just what is best. Flax seed jelly is good. Simply take the whole flax and put it in hot water and make a jelly, and put that in the milk.

As soon as the little calf is old enough to change from whole milk to skim milk, give him a little shelled corn right after each meal, and I say you can make them grow just as well that way as by sucking the mother. Some men say that is not so. It will not do to have one big trough for them all to come to, because the big ones will get too much and the little ones will get pushed back, and then the next day another one will get too much. No, that will not do. Every calf must have his own place to eat. The best plan is to have little box stalls—one for each of your calves—have the stalls six or eight feet square; but another way is to put each little head in a pair of stanchions; they will soon learn what it is for, and in that way each one will get just what he wants, and no more. Now, after they are through drinking, what shall we do? Turn them loose? No, I would not turn them loose right away, because they will suck each others ears; that's a bad habit. Do you know how to cure them of that habit? Why, by giving them something else to do. As soon as they are through drinking, put some shelled corn in where they had the milk. Why not grind it? No, it is better to shell it. By the time that is eaten they have forgotten all about sucking ears. Then you can turn them loose. How much shelled corn shall we give them? Just all you can get them to eat and digest. Why not give them just a little shelled corn? I will tell you why—because the earlier you can get that corn into them the more of it will stick to their ribs. When they are babies what they eat sticks to their ribs. There is a reason for that. All human bodies are made up of small particles called cells. But here is something you have not thought of. Do you know that each little cell is a living thing? Each almost independent of the other. Did you know that? You think of me as being one man; but I am more than Joseph Wing; I am the republic of Joseph E. Wing, composed of thousands of cells, all alive. Sometimes these cells co-operate with each other and sometimes they do not, and then the devil's to pay.

Now, in the case of babies, these little cells are very much alive. All babies have good appetites. Did you ever see a baby not hungry? They are sick when they are not hungry. What does it mean when a baby is hungry? His little stomach has telegraphed to the brain that it wants some food, that it is ready to take care of some food.

Now, you must give these little calves all the corn they want to eat. No, not quite all. Do not heap up the box running over, but give them about three grains less than they want. When you give them all they want, and a little more, and they come up to it and look at it and say, "there is that stuff that tasted good while I was eating it, but it made me sick." Sometimes I tell a little story in this connection as to how to keep your sweethearts in love with you—how to keep them so they are always glad to have you come back the next time. It is just so easy. Just leave your girl five minutes before she wants you to go; and when you go back next time she will open the door wide and say, "Why,, it is John; come right in." But if you stayed too long the last time she will say, "there's that fellow that made me so tired the last time he was here."

So, give the little calf plenty of good, clean, warm milk, and plenty of alfalfa and red clover hay. And make them good beds. Timothy makes good bedding for these baby steers. Have their beds clean; sometimes white scars form on them, caused from lying in a dirty place. Then make your calves think you love them. I tell you babies get fat on love; I never have known a man to make a success of the business if he did not love them. They have simply got to have it.

Now, then, keep this feeding up all winter. And have them born in the fall, if possible. The flies are not so bad in the winter, and by the time the flies come the calves' tails are so much longer and their hides are thicker. During the summer give them some red clover and alfalfa in a dark basement, and let them run out at night. Feed them every day, and don't forget a single day.

When spring comes it is a great temptation to turn them out on the green grass—but you must not do it. All the cattle I ever lost died when the green grass came. There is no strength in green grass. Get them used to the green grass before you turn them out—let them have it in this dark basement, and make them beds of it there to sleep on. Let them have some of the green clover and the dry clover and alfalfa, and let them run out at night and eat their grain. Keep this up until they are ready for market, and by the time they are a year old they will weigh 1,150 pounds. Some say they cannot afford to feed them the year round on grain. Is it better to let them run for three or four years and then feed them all at once for market? What does it cost to feed them? A series of forty-five experiments show that for the first year of their baby life it costs $3.50; the second year, $7.10; the third year, $11.00, and the fourth year, $19. Now, that is when they are fed right from the ground up; and you will find it costs you more if you wait until the last to feed them. Do not neglect the opportunity to feed them when babies, when a pound of food makes the biggest gain. This opportunity means so much. Think about it. Just give them the opportunity to satisfy that little appetite of theirs—just the opportunity to lie in the sunshine on a green bed—just the opportunity to hear kind words; and those little calves will make their owner rich.

RESOLUTIONS.

(Adopted at the Ninth Annual Meeting of the Missouri Improved Live-stock Breeders' Association.)

I. On behalf of the visiting farmers and delegates, we wish especially to thank Hon. Geo. B. Ellis, Secretary of the State Board of Agriculture, and Dr. H. J. Waters, Dean of the Agricultural College, for their untiring efforts to promote the interests of the Association and the development and upbuilding of Missouri agriculture.

To the students and professors of the Agricultural College, the officers of the University and the citizens of Columbia we extend our most hearty thanks for their hospitality, their assistance and valuable instruction.

II. We would strongly urge upon the United States Congress the advisability and necessity of enacting into law what is known as the Adams Bill, providing for the support of the Experiment Stations of each state.

III. We would strongly recommend to the Missouri Legislature the importance to the live stock industry of our State of enacting a law preventing the adulteration of stock foods and charging the Experiment Station with the enforcement of the same in a similar manner that is now provided for the regulation of the sale of commercial fertilizers.

IV. We would further recommend that the Missouri Legislature enact, at its next session, a suitable pure food law, and require that the Experiment Station analyze each year all brands of prepared commercial foods, drugs and liquors intended for human consumption.

V. Resolved, That we heartily endorse the purpose of the American Reciprocity Convention, lately in session at Chicago, and the Reciprocal Tariff League, appointed by said convention, in its efforts to preserve and enlarge our foreign trades; and that we urge upon our representatives at Washington that they use every legitimate means to establish more rational trade relations between America and Continental Europe, and especially with Germany; that a copy of this resolution be sent to the President of the United States and to Missouri's Congressmen and Senators.

Resolutions relating to the extermination of the Texas fever tick in the quarantined states:

Dr. Conway: Mr. Chairman and Members of the Association—I wish to call the attention of the Association to resolutions that were passed at a meeting of the Association of the Commissioners of the Cotton Growing States, held recently at Richmond, Virginia.

These resolutions relate to the extermination of the southern cattle ticks ("Boophilus annulatus"), which transmit Texas fever from infected to non-infected cattle.

There are fourteen states and territories lying wholly or in part within the Texas fever quarantined district.

This vast territory is capable of increasing the cattle production many fold under the better conditions, which the people of that section are earnestly working for.

As breeders of improved cattle, you know what a serious drawback Texas fever has been for many years to the cattle traffic between the north and the south. At present *immunization* by inoculation is proving of great benefit; but this process, as valuable as it has proven to be, is at best a necessary evil, and will never fuly meet the needs of the situation. The radical cure of exterminating the ticks must be the ultimate solution of the question. That this is feasible has been clearly demonstrated in various parts of the south.

The clearing from ticks of areas of considerable extent has already been accomplished, and this has led to a desire, on the part of the Commissioners of Agriculture and many stockmen, for the inauguration of co-operative action on the part of the quarantined states and the Federal government, in order that more rapid and more effective work may be done.

Their resolutions are as follows:

Whereas, The appearance and spread of the Mexican cotton boll weevil over the entire cotton-producing area of the United States forces upon the south a new regime in agriculture, that is, diversification; and,

Whereas, Lasting success in all agriculture rests upon an intelligent and profitable animal husbandry; and,

Whereas, The entire south is admirably adapted to the production of cattle, if it were not for the presence of the North American cattle tick ("Boophilus annulatus"), which tick makes the most profitable cattle growing upon the farm impossible; and,

Whereas, The situation concerning this cattle tick is little understood by the people that will have to contend with it in the near future, and which circumstance will lead to great losses and is likely to bankrupt many farmers; therefore, be it

Resolved by the Association of the Commissioners of Agriculture of the Southern States, That we request the Congress of the United States to appropriate the sum of $500,000 to be expended under the direction of the Secretary of Agriculture in the extermination of the cattle tick, "Boophilus annulatus," and in the seeking and disseminating of such knowledge that will prevent the enormous losses already suffered by the farmers of the south.

Resolved further, That this Association consider it the duty of the Commissioners of Agriculture of the quarantined states to use every effort to secure such legislation as is necessary to obtain effective co-operation between the State and Federal authorites, and to use and secure in each state funds for the protection of its proper share of this work.

Resolved further, That copies of these resolutions be transmitted to the Chairman of the Committees of Agriculture of the United States Senate and House of Representatives, to the Honorable Secretary of the United States Department of Agriculture and to the Representatives of the southern states in Congress."

Dr. Conway: Mr. Chairman, I favor the endorsement of the resolutions for reasons I have given and for the reasons contained in the resolutions themselves. I understand that United States Representative Richardson of Texas has introduced a bill in Congress appropriating $75,000 for exterminating the "fever ticks." It will be fortunate, indeed, if this amount is sufficient, as the ends sought will be cheaply attained even by the expenditure of the larger amount asked for in the resolutions of the Commissioners of Agriculture.

Mr. Gabbert: I heartily favor the resolutions. The cattle fever has been a great hindrance to trade and there has been considerable talk among our breeders of establishing an immunizing station near the quarantine line in Texas, where cattle from various parts of the north could be sent and immunized and then distributed from that point to various parts of the quarantined district. But the complete destruction of the ticks would be much better. We could then exhibit cattle at the southern cattle shows without suffering the great loss which fell upon Mr. Sotham and other breeders who exhibited at the Charleston Exposition. Besides, the southern breeder could show in the same ring with us at our northern and western fairs and not have to show separately, as was the case at the St. Louis Exposition.

I am in favor of anything that will remove the quarantine and render the trade in cattle between the north and south free and safe. The estimated cost will be a small matter in comparison with the benefits that will accrue, not only to the south, but to all parts of the country.

Mr. Waters: Missouri's part in such an appropriation as was asked for from the Federal government would be much less than our present expenses in maintaining a quarantine against the southern part of the State. Thus the passage of such a law as is provided by the resolution would save the Missouri tax-payer money rather than increase his burden. Besides, it would be of special value to the Missouri breeder, inasmuch as he has more surplus stock than anyone else to sell, and is more interested in securing this southern trade than anyone else.

It is likewise true that the Missouri feeder is much interested in this matter, inasmuch as it will be greatly to his advantage to secure feeders from this great cattle-producing territory at any season of the year that he may require them, without the danger of infecting his farm and communicating a dangerous disease to his other stock.

Motion to endorse the resolution carried unanimously.

THE MORE IMPORTANT INSECTS INJURIOUS TO CORN IN MISSOURI.

(By J. M. Stedman, Professor of Entomology in the University of Missouri and Entomologist of the Experiment Station.)

In the annual report of the Missouri State Board of Agriculture for 1902 I published an article on "The More Important Insects Injurious to Wheat in Missouri." That article was complete in itself, in so far as the most injurious insects are concerned, but as that annual report has long since been exhausted and cannot now be obtained by anyone, it is advisable to make this article on the corn insects also complete in itself. This will necessitate, therefore, the introduction into this article of some of the insects described in the article on wheat insects, because of the fact that they are equally injurious to the corn plant. However, by so doing, anyone obtaining either one or the other of the two articles will have a complete outline of the more important insects injurious to that particular plant. If the work on wheat insects were not out of print and could be obtained at this time, I should not include in this paper insects discussed in that article.

We now recognize two hundred and fourteen different species of insects that are injurious to the corn plant. In this short article we will discuss only those that are the more common and destructive, and that the corn growers are likely to suffer from every year in some part of the State of Missouri.

THE SEED-CORN MAGGOT.

Pegomyia fusciceps, Zett.

The seed-corn maggot is the larva of a fly which measures about one-fifth of an inch in length. This insect is supposed to be an imported one, and is now found scattered over the northeastern quarter of the United States. The larva feeds by burrowing into the roots of radishes, cabbage, turnips, onions, peas, beans and mustard, as well as the seed of corn after it has been in the ground for several days and has become soaked and swollen and somewhat soft; and it also has been known to feed upon the eggs of grasshoppers. The exact and complete life history of this insect has never been fully worked up, but from what observations have been made, it is supposed that the insect has two broods a year.

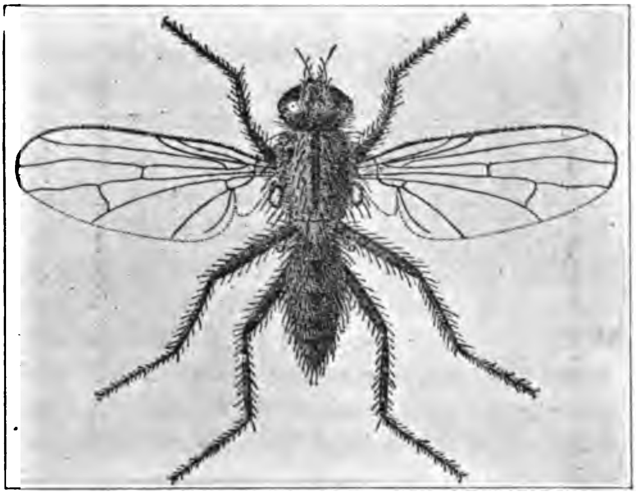


Fig. 1.—Adult Fly of Seed-Corn Maggot, *Pegomyia fusciceps*, Zett.; enlarged eight and two-thirds diameters.

While this insect does nothing like the amount of damage to seed corn in the ground that wireworms do, it may, nevertheless, at some future time, especially in certain localities, become an important insect in this respect. The larva is not able, apparently, to injure the seed corn until it has been in the ground long enough to have become soft and swollen, after which the insect will eat its way into the kernel, mining it out, especially about the embryo, which it usually kills. The larva will also feed by mining in the young root after the seed sprouts, so that the insect in either case is sure to kill the young plant by preventing its development or the seed from sprouting, as the case may be. A larva is shown magnified eleven diameters in figure 2, and a larva is shown feeding inside of a kernel of corn in figure 3, this larva being about natural size.

The larvae may be found from the middle of May until the middle of June. The pupa stage is passed in the ground, and it is usually more abundant during the first two weeks in June. The adults may be seen flying about from the middle of June until the middle of August. A pupa is shown in figure 4, magnified about eleven diameters, and an adult insect is shown in figure 1, magnified about nine diameters.

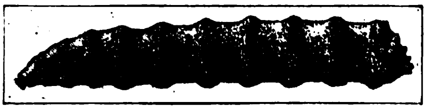


Fig. 2.—Seed-Corn Maggot; enlarged eleven diameters.

There seems to be no good method yet devised for fighting these insects in the field, although at some future time, if they should become so abundant as to require the entire replanting of the field, or a portion of the field, no doubt a good deal of good could be done by soaking the seed corn in water over night and then mixing the corn with a large quantity of Paris green, so as to cover each kernel just before planting, and thereby kill the insect while trying to eat its way into the kernel. This method, however, has never been tested on a large scale.

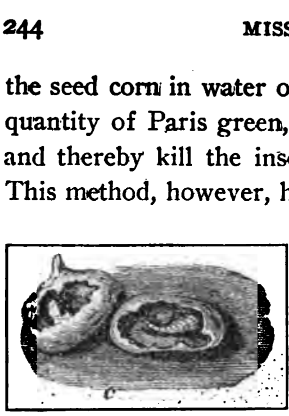


Fig. 3.—Seed-Corn Injured by Seed-Corn Maggot; natural size.

The adult insect can be determined by the ordinary corn grower from its general shape, which one will recognize by the figure, and also by the fact that the insect is about one-fifth of an inch in length, and just a little over one-third of an inch across its expanded wings. The front is fulvous, with a narrow brown colored margin and the face of a light brownish color. The antennae, palpi and proboscis are black. The area occupied by the ocelli is heart-shaped. The abdomen and the thorax are light yellow, with brown colored sinereous spots, more or less covered with minute black points at the intersection of the bristles. The back of the thorax has a distinct dark brown stripe down the middle, as can be seen in the illustration. The legs are black. The puparium, inside of which the true pupa is found, measures a little less than one-fifth of an inch in length and is of an oblong shape, similar to the figure of a pupa above indicated. It is of a reddish-brown color, narrowly rounded at each end. The posterior tubercles are all present, although shrunken and surrounding the posterior stigmata. The larva is about one-fourth of an inch in length, and is quite thick at the widest part, which is near the posterior extremity. The posterior half of the body is cylindrical, and from this point to the anterior portion, becomes tapering with increasing rapidity to the anterior end. The insect is of a dirty yellowish white color, with the last segments considerably darker. The segments are distinctly seen.

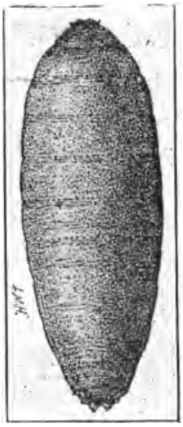


Fig. 4.—Pupa of Seed-Corn Maggot; enlarged ten and one-half diameters.

THE CORN WIREWORM.

Melanotus cribulosus, Lec.

The well-known wireworms are the larvae of beetles that are popularly known under the names of Click-beetles, Snap-beetles, or Snapping-jacks. These beetles are well known to every country lad, and more or less even to the town boys, because of the peculiar habit these beetles have of bending their bodies when held in the fingers and suddenly straightening out with a snapping sound, which results in a considerable jerk; and also on account of the fact that if these beetles be placed on their backs on a hard substance, they will go through this snapping motion and thereby be thrown into the air for a considerable height and perhaps alight on their feet. This habit enables these beetles to regain their feet should they fall and lie on their backs, for otherwise they would be unable to turn over.

There are in Missouri about one hundred species of these insects, and while a great many of them are injurious in the larval stage, we will confine our remarks more especially to the two most injurious species infesting the corn plant, one of which has gained the common name of the Corn Wireworm. This insect is by far the most common wireworm found in the corn field, but the wheat wireworm is a close second. There are other species, however, that quite commonly infest corn, viz., the *Drasterius elegans* Faber., which is in many places at times almost as injurious to corn as is either the corn wireworm or the wheat wireworm. The adult of *Drasterius elegans* is represented in figure 7, enlarged seven and one-half diameters. A larva enlarged seven diameters is also represented at figure 7. I do not think it necessary to enter into a discussion of the life history and methods of work of this insect, since it is so nearly related to the other two which we will discuss more fully.

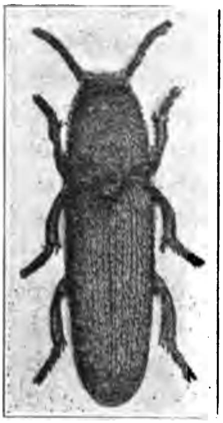


Fig. 5.—Adult Corn Wireworm, *Melanotus cribulosus*, Lec., enlarged four and one-half diameters.

The corn wireworm, like practically all wireworms that infest corn fields, do a great amount of their damage by eating into the kernel of corn soon after it is planted in the ground and hollowing out the inside, sometimes eating the entire kernel. They will also eat of the kernel after it has swollen as well as before, and after it has sprouted, and they will also attack the young corn plant, eating the roots or eating through the stem near the surface of the ground, thus killing the plant even after it has become a foot or two in height. These insects, as a rule, infest more especially certain localities of a large corn field, and

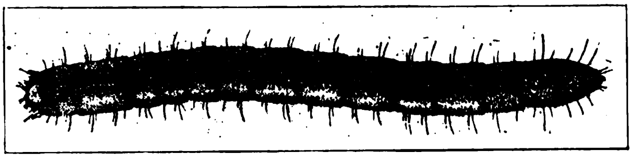


Fig. 6.—Corn Wireworm; enlarged four diameters.

in many cases require the replanting of the corn for the second or even the third time. These wireworms cause more damage to the corn when first planted and to the young plant than all other corn insects combined. Almost invariably when the corn fails to come up it is due to the attack of wireworms, and in most cases when the corn has appeared above ground for a foot or less and then withers and dies it is also due to the attack of wireworms.

The adult beetles lay their eggs in grass fields early in spring and the larvae (which are known as the wireworms) feed upon the roots of the grass. They are long, narrow, cylindrical, hard, glossy insects, tapering abruptly at both ends, usually of a brownish or yellowish-brown color, and with very few hairs. Figure 6 represents one of these larvae, magnified four diameters. They may exist in the grass without any particular notice, frequently as many as twelve of these insects being in a spadeful of sod, and yet not causing any appreciable damage to the same. They will be found feeding upon the roots of all kinds of grasses, either in the field, or along fences, or in out-of-the-way places. This corn wireworm requires two years to complete its life cycle, the larvae hibernating in the ground around the roots of the grass during the first winter, beginning to feed in the following spring as soon as warm weather arrives, then transforming to pupae in the ground along in July

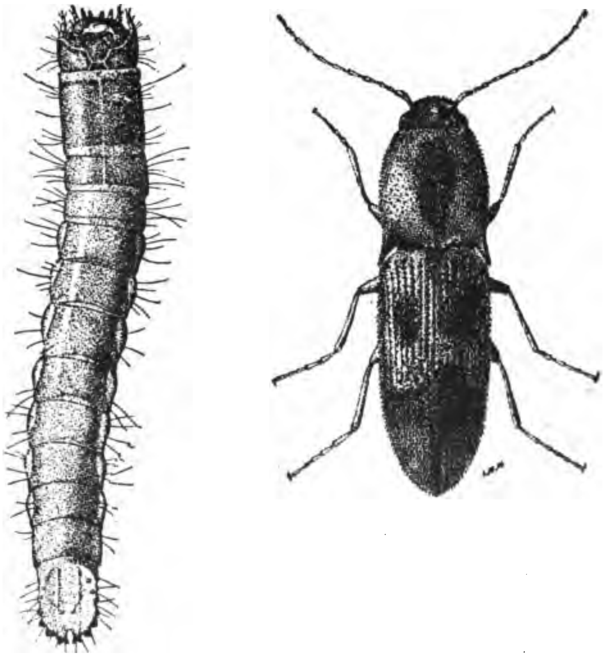


Fig. 7.—A Common Wireworm, *Drasterius elegans;* Larva magnified seven diameters; adult beetle magnified seven and one-half diameters.

or the forepart of August. Just before the larvae transform to pupae, they wriggle their bodies and pack the earth away from the same, so as to make a little earthen cell, inside of which the pupa stage is passed. The pupae transform to adults along the latter part of August, but remain in these earthen cells, as a rule, over winter and until the following spring.

The larvae of these wireworms, like those of practically all other species, are extremely hard indeed to kill by any of the arsenical poisons. They will eat arsenic, strychnine, etc., without any apparent ill effects, so that the theory that these insects can be poisoned by soaking the corn and rolling it in arsenic or strychnine or other poison before planting has no value whatever. It is absolutely impossible to kill these insects out in the field by any poison method known. The larvae, or wireworms, are also extremely tough, so that one may step upon them upon the ordinary soft ground and not injure them at all, as they will be pushed into the soil before being crushed. When these larvae transform to pupae, however, the pupae seem to be unusually delicate and are easily killed by simple disturbances which would not injure in any way the pupae of most insects. Even the rupturing of their earthen cells is frequently sufficient to kill them, and the thorough disturbance of the earth, such as takes place in plowing and harrowing, will kill the most of them. This is also the case with the young beetles when they first emerge from the pupae. They are very soft bodied, of a light yellow color, and are easily killed by any great amount of movement of the soil. They very gradually indeed attain a hard covering and their dark coloring. The adult of the corn wireworm when fully matured and in its normal condition is represented in figure 5, enlarged four and one-half diameters. It is brownish fuscous in color, the upper part of the thorax being densely punctated and the sides shiny. They are about one-third of an inch or a little over, in length, and are our most common adult wireworms

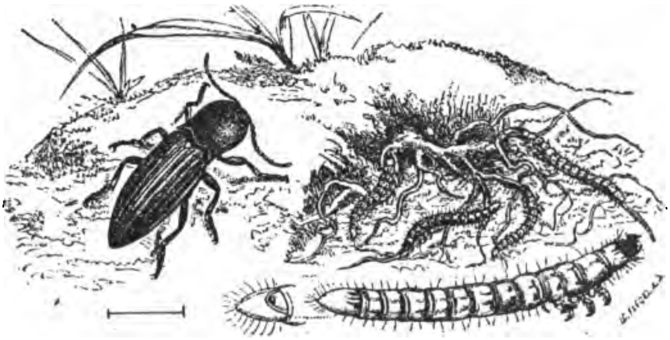


Fig. 8.—A Common Wireworm: Adult and larva, enlarged; and young larvae feeding on roots of grass. The line below the beetle indicates its natural size.

found in wheat fields. The larva is represented in figure 6, magnified four diameters. The larva is two-thirds of an inch, or a little over, in length when full grown.

The methods for fighting these insects are the same as we use for all wireworms, and the reader is therefore referred to the discussion of the wheat wireworm, which is the next most destructive wireworm infesting our corn.

THE WHEAT WIREWORM.

Agriotes mancus, Say.

The larva of the wheat wireworm beetle is also one of our most common and injurious wireworms found in the corn field. The adult is a small, dark, brown, oval shaped beetle, nearly one-third of an inch in length, with the body densely covered with minute hairs, which, however, would not attract the attention of the ordinary observer unless he were to look at the creature under a hand lens. The beetles are hard and quite slippery when held in the fingers, and are very apt to wriggle away from one when thus carelessly handled. A good idea of the general appearance of these beetles can be had by observing figure 9, which represents one magnified seven diameters. These beetles appear along in the spring of the year, usually during April, at which time they may be found hiding under clumps of grass and clover growing in meadows and pastures, and along the fences and byways, also under logs, stones and other secluded places in the fields and along outskirts of forests. These adults fly readily, and also scramble over the ground with considerable rapidity.

They lay their eggs in cultivated and uncultivated grassy meadows and other places. When these eggs hatch the little larvae burrow in the ground and feed there upon the roots of various grasses and clover.

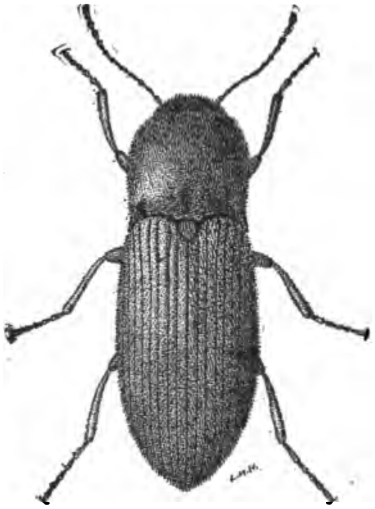


Fig. 9.—Adult of the Wheat Wireworm, *Agriotes mancus*, enlarged seven diameters.

These larvae grow very slowly indeed, at least in comparison with the larvae of some insects, still not as slowly as do some well known insects, as, for instance, the seventeen-year locusts. The larvae remain burrowing through the soil and feeding thus upon the roots of the grass and clover until the approach of cold weather, when they hibernate wherever they happen to be, usually, however, having previously entered the ground to a somewhat greater depth for this purpose.

Next spring they become revived and feed again upon the roots of the clover, grass and allied plants, continuing thus to feed and gradually growing during this second summer. At the approach of cold weather again they likewise libernate under the ground near the plants, upon the roots of which they have been feeding. The next spring, at the approach of warm weather, they again become active and feed as before until July. By this time the larvae have become full grown. They are generally about three-fourths of an inch in length, of a pale, waxy, yellowish brown color, cylindrical in shape, being practically of the same diameter from end to end, and tapering or rounding bluntly at the two extremities. They are distinctly ringed, and are unusually hard, so much so that when taken in the hand their bodies do not seem to give, and if stepped upon on an ordinary plowed field, will be pushed into the soil instead of crushed. This hard character of the body, together with the shape, has given to them the well known name of wireworms. Their bodies are thinly clothed with a few hairs, which, however, are not ordinarily observed by the agriculturist. An excellent idea of the general shape and appearance of these wireworms will be had by observing figure 10, which represents a dorsal and a lateral view of one of these larvae, magnified five diameters.

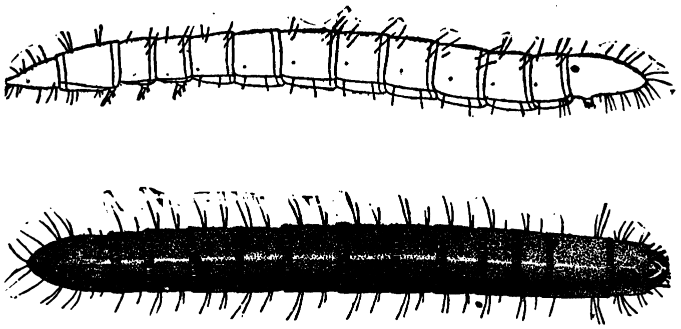


Fig. 10.—Larvae of the Wheat Wireworm. ***Agriotes mancus,*** **enlarged five diameters.**

This particular species can be readily distinguished from the other common wireworms by observing the last segment of the body, which is smooth and conical in shape, and has two dark colored pits upon its dorsal surface, as can be seen by referring to the figure just described. The wireworms have three pairs of small joined legs, one pair on each of the three first segments following the head, but the rest of the body is devoid of the fleshy prolegs, which are so commonly seen in ordinary caterpillars with which the farmer is so familiar.

During July these full grown wireworms crawl a little deeper into the soil, and there wriggle their bodies until they have packed the earth away and thus made a little cell in which they change to pupae. These pupae are entirely different in shape from the wireworms, and more closely resemble the adult beetle in shape. They are a little longer, however, and their bodies are almost a pure white in color. While the wireworm larvae are so extremely tough, these pupae are extremely and unusually delicate and tender—a character we may take advantage of in controlling this insect in our cultivated fields.

In three or four weeks these pupae change to adults. These new adults are of a light cream color, and are likewise extremely delicate and tender. They remain in these earthen cells, and very gradually attain the normal color of the insect, and also gradually become hardened. These adults now remain in these earthen cells during the rest of the summer and fall and throughout the winter, and come forth the next spring, usually during April.

From what has been said, it will be seen that the larvae are three years in reaching their full grown larval stage, during which time they remain almost constantly beneath the surface, readily burrowing through it and feeding upon the roots of clover and various grasses. The pupae stage lasts but a comparatively short time, and the adults that come from these pupae remain in a quiescent condition for an exceedingly long time before they attempt to free themselves and assume an active life. It will also be seen that while the larvae are unusually tough and hard to destroy, as are likewise the adults that have appeared above ground, yet the pupae and the young adults are unusually tender and very susceptible to any disturbance of their subterranean cells. It might be well to mention in this connection, however, that not all wireworms require three years in order to reach the full grown larval condition, and that we have reasons for believing, on the contrary, that others required even as much as five years in order to complete their full larval life.

REMEDIES.

Meadows and pastures and other grass lands may be very badly infested with wireworms and yet show no particular indications of their presence, or at ealst do no appreciable amount of damage such as the farmer would observe. These grassy fields and byways may be thus badly infested for a good many years, and their presence not observed until such places are plowed, when they may find these wireworms in such immense numbers that a single cubic foot of earth may contain fifteen to twenty of them.

When such infested fields are plowed and planted to some crop such as corn, wheat or other grains, or, in fact, most any farm or garden crop, these wireworms are deprived of their great abundance of food, and then show their presence by the great injury which they do by feeding upon the roots of the comparatively small amount of plants that have been introduced there by the agriculturist.

Wireworms do not confine their attacks to the roots of corn and other cultivated plants, but will attack the corn or seed when put in the ground and before it has had time to germinate, and will eat holes through it, hollowing it out inside or devouring it entirely. Those seeds that have succeeded in germinating are also attacked and the young developing roots eaten, or the plants that have succeeded in reaching several inches in height will have their roots eaten or holes eaten through them, and even the base of the stem eaten into and the plant killed. The farmer, however, usually complains most severely of the attack upon the seed of the corn before it has had time to germinate. It appears that those corn fields (this also applies to wheat fields) which are in low ground, or those portions of larger fields that are in low or hollow places, are more liable to injury from wireworms than are the higher and better drained fields or portions of fields. In some instances it also appears that corn planted the second year after the plowing of the meadow or pasture seems to suffer more from injury from the attack of wireworms than it did the first year from plowing. In such instances it appears that the young wireworms had sufficient food remaining in the form of the roots of the original grass to sustain their life for the first season, and that by the next spring the roots had decayed and disappeared sufficiently to deprive them of food and forced them to then attack the cultivated plants. It is also frequently the case that the wireworms do the greatest amount of damage during the spring, apparently their long winter fast having sharpened their appetites, which become somewhat satisfied later in the season.

It is almost impossible to poison the wireworm, either in the adult or larval stage. Certainly the poisons in our ordinary insecticides are not strong enough to kill them. The application of various chemicals to the soil will not injure them unless used in such unreasonable quantities as to utterly unwarrant any such procedure. The only successful method of killing the wireworms that I know of is to take advantage of the weak point in their life history, which I have before described, viz., the extremely delicate condition or the pupae and newly developed adults. It has been found by Professor Comstock that these insects are so readily killed, when in the stages mentioned that, by plowing the field to a depth of at least six inches and harrowing it thoroughly, that this disturbance of the insect, due to the rupturing and destroying of its earthen cells, is sufficient to kill it at this time. This explains the well known fact that plowing is the best remedy.

Infested corn, wheat and other grain fields, or sod land intended later for such crops, should be plowed deeply during August and harrowed several times, and if necessary, plowed and harrowed again before September, with a view to destroying the insects in the stages mentioned. It must be borne in mind, however, that since these insects require three years in order to reach their full grown larval condition, that only one-third of the insects in the field may be destroyed; but it must be borne in mind that unless this one-third is destroyed they will hibernate, and the next spring will deposit eggs for a greatly increased number of wireworms to follow.

If this simple method just described above is carried out each year, one will soon cease to be troubled with wireworms. Fields that are plowed during August of each year, or that are plowed even during September of each year, are rarely infested with wireworms in sufficient numbers to cause any mischief.

THE CORN-ROOT-APHIS.

Aphis maidiradicis, Forbes.

The corn-root-aphis is the most interesting insect infesting the corn plant, and yet, in the long run, it is probably next in importance to the chinch-bug as regards the injury which it accomplishes. The corn-root-aphis is very generally distributed throughout the corn growing belt and is found every year in some localities in damaging quantities, although in some regions the insect may be at certain times scarcely noticeable and at others unduly so. The fact that it is so generally distributed and so common in practically all corn fields, at least sooner or later, makes, in the aggregate, an injury which is perhaps next to the injury by the chinch-bug, which has more decided spasmodic occurrences. During the past two years I have received more letters from farmers in regard to this insect than I have concerning any other insect infesting the corn plant.

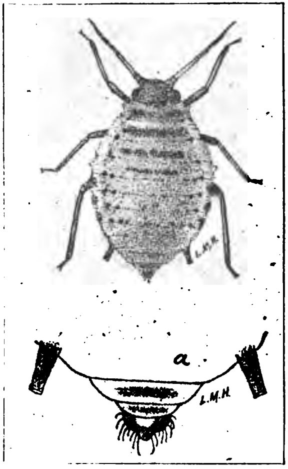


Fig. 11.—Corn-Root-Aphis, *Aphis maidiradicis*, wingless viviparous female; greatly enlarged; *a*, apex of abdomen still more enlarged.

The injury which this insect does is to extract the sap from the roots of the corn plant, thus weakening the entire plant and causing it to be stunted, or to make nubbins instead of a full ear. The injury varies all the way from a scarcely appreciable effect to the complete destruction of the corn plant. The complete destruction of the corn plant, however, is very rare indeed, unless the work of this aphis be supplemented by long continued drought. In fact, the work of the aphid has the same effect upon the plant that a long severe drought has, they simply extracting the sap, which amounts to practically the same thing as the want of sufficient moisture in the ground would have upon the plant; and when these insects are quite numerous and a drought occurs, the plants, of course, suffer unduly and the crop may be entirely ruined, provided a drought occurs as a supplement, which of itself would not necessarily cause such an injury. It is the supplementing then of the injury by the aphis which causes the serious trouble.

The corn-root-aphis is recognized, I think, by all corn growers. The insect affects the corn plant only upon the roots under ground, but every corn grower has pulled up infested corn and observed these small, bluish-green plant-lice, or aphids, sometimes occurring in large clusters upon the roots. These insects can be found on the corn roots before the corn is out of the ground, in fact, when the root first begins to appear nicely from the seed, and they may be found upon the corn plant until it is completely matured.

The life history of this insect is interesting and can be briefly described as follows: The so-called winter eggs are fertilized eggs. They are deposited by the female aphids late in the fall. These eggs are oval, black and glossy, and, of course, quite minute. They may be found about the roots of the corn plant late in the fall, in the burrows of the little red ants that are so common in these situations. There are two species of these little red ants that one finds very numerous throughout the corn fields and other fields about the country (*Lasius niger* and *Lasius niger alienus*), which little red ants are our most common ants filling this description. A picture of one of these ants is given enlarged eight and one-fourth diameters in figure 12. This is a worker ant, and, of course, constitutes the bulk of the in-

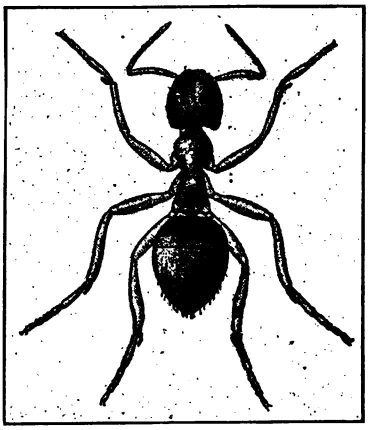


Fig. 12.—*Lasius niger alienus*, worker ant; enlarged eight and one-fourth diameters.

dividuals in a colony. In figure 13 we have represented enlarged four and one-half diameters, the fully developed, winged female, at the time she is able to leave the nest and fly in the air as a winged creature.

The nests of these little red ants will be found in great abundance along paths, roadsides, through fields, and especially in the corn field, where they make little holes in the ground, near the entrance of which one finds a little bunch of earth which the insects have carried out in making their subterranean tunnels, which radiate through the earth for about one and one-half feet in diameter and about seven or eight inches in depth. These ants have the habit of making their nests about the roots of the corn plant, and the roots are exposed in their chambers and run-ways, and upon these roots live the aphids, which lay the winter eggs above described. When they wish to deposit their eggs, they are very apt to leave the roots and wander about the chambers and tunnels of these little red ants and deposit their eggs here and there as they walk along. These ants gather the eggs that the aphids have deposited and store them in masses in their chambers which they have excavated, and there watch them and guard them throughout the winter. During warm, sunny days they will carry these aphid eggs up near the surface so that they may become warm, sometimes putting them out and exposing them to the sun and taking them down again at night or during stormy weather, and during cold weather, placing them in the lowest chambers, apparently trying to keep them away from the excessive cold. They watch over and take care of these eggs until they hatch in the spring of the year. These eggs always hatch into wingless, agamic females, which bring forth living young without the appearance of males.

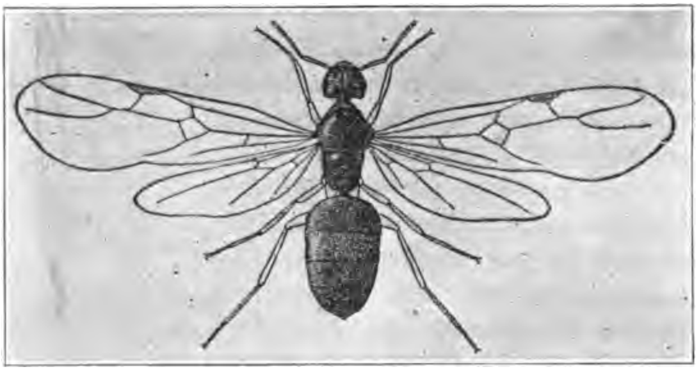


Fig. 13.—***Lasius niger alienus*, female; enlarged four and one-half diameters.**

When these eggs hatch in the spring, the ants burrow down among the roots of smart-weed, which always springs up in the corn field long before the corn is put in the ground and place the aphids on the roots. These aphids cannot reach the roots of the smart-weed plant by their own exertions, but must be placed there by the ants. They then extract the sap from the smart-weed and soon become grown, bringing forth living young, thus establishing a colony at this place.

I might add here that the reason that these ants take care of the aphid eggs and of the aphids in the way they do is because of the fact that these aphids excrete a sweet liquid which the ants feed upon and prefer to any other food. Figure 11 shows one of these aphids greatly enlarged. You will notice two short tubes projecting from near the end of the abdomen. These are known as honey tubes. They are represented more enlarged at a.

While these aphids that hatch from the winter eggs are continually bringing forth living young, in about two weeks their offspring are able to bring forth living young also, these offspring being wingless, agamic females also. Thus in a very short time we have a very large colony of these aphids established upon the roots of the young smart weed. After a time we have produced from these wingless, agamic aphids, by bringing forth living young, some aphids that have wings. One of these young aphids just developing its wings is shown in figure 14, enlarged twenty-one diameters, and a full grown one with its fully developed wings is shown enlarged sixteen diameters in figure 15.

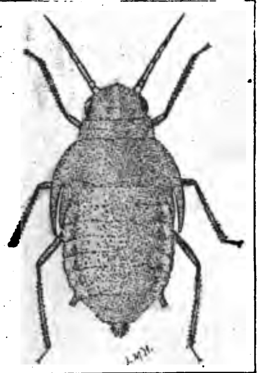


Fig. 14. — Corn-Root-Aphis, *Aphis maidiradicis* pupa; enlarged twenty-one diameters.

These winged aphids leave the colony and fly through the air without any apparent thought on their part as regards direction. They are very apt to be carried by the wind, sometimes for considerable distances. They may alight in a corn field or in a grass field, as the case may be, the whole matter seeming to depend wholly upon chance. If these aphids alight in a grass field, the little red ants that are always found there take them and carry them to their burrows and place them upon the roots of fox-tail or pigeon grass, which may be found in these fields. On the roots of these plants the aphids extract the sap and bring forth living agamic females, thus establishing a colony. If, however, the winged, migrating aphids happen to alight in a corn field, which corn field may be the first year following grass or other crop, these ants, which are always found there, will also carry the aphids to their burrows, which are down about the roots of the corn plant, and place them there, where they also bring forth living young, which are without wings, and thus establish a colony.

This developing of some winged individuals takes place more or less throughout the summer, from the middle of May to the last of October; but understand that not all of the aphids, by any means, that are produced during the summer have wings—only a portion of them. The others are without wings and cannot migrate so as to distribute the species, but must remain upon the plants where the ants take them. The winged, or migrating aphids, like the wingless ones, are unable by themselves to reach the roots of their food plants or to establish themselves and live without the aid of these little red ants.

To go back to where we had the aphids placed by the ants early in the spring, upon the roots of the young smart-weed that was appearing before the corn is planted; later there develops in the corn field the fox-tail or pigeon grass, and these ants will now carry some of these aphids also to the roots of this grass, so that we find in the corn field before the corn is planted these ants attending the aphids which they have placed upon the roots of both smart-weed and pigeon grass. Later, when the corn is planted and sprouts, the ants make their burrows and nests about the roots of these young corn plants, and before the plant has shown above ground, they carry some of the aphids to the roots of the corn plant, and a colony is established there in the same way as described upon the roots of the other plants. A little later you will find practically all of the aphids transferred to the roots of the corn.

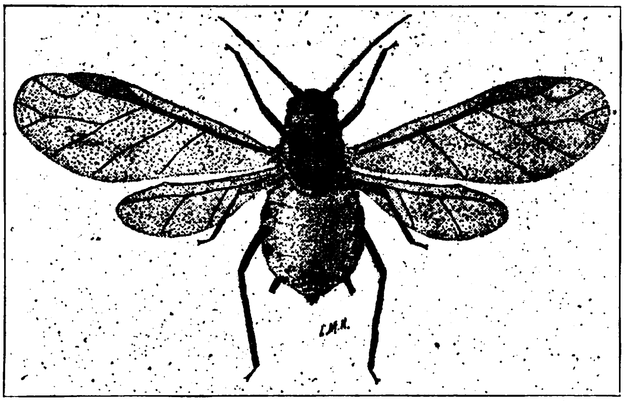


Fig. 15.—Corn-Root-Aphis, *Aphis, maidiradicis*, winged vivaparous female; enlarged sixteen diameters.

Understand that these aphids are continually bringing forth living young and their off-spring doing likewise all summer long, so that we have the insects increasing with great rapidity upon the roots of the corn. The greatest amount of damage, however, appears to be done while the corn plant is small. The fact that these aphids are frequently more abundant upon the roots of corn in the low places in the field is simply due to the fact that the rains have washed the seed of smart-weed and fox-tail or pigeon grass to the low places, and the presence of large numbers of plants of this weed appearing there early in the spring has attracted the ants, and they have placed the aphids in these situations, and when the corn is planted the ants simply removed the aphids a short distance to the corn.

When the corn plant becomes too old for the aphids to derive nourishment from its roots, the ants, which have during the entire season obtained practically all their food by feeding upon the so-called honey-dew, which has been excreted by these aphids, then carry the aphids from the roots of the corn plant to the roots of purslane, which by this time has developed throughout the corn field. The aphids stay upon the roots of the purslane through the fall, and it is usually about the roots of this plant that the eggs are deposited in the burrows of the ants.

In the fall of the year there are developed from these wingless agamic females, which have been bringing forth living young during the entire summer, generation after generation, without laying eggs and without the appearance of males, in the same way now bring forth certain individuals which are true males and true females. A picture of one of the males is shown in figure 16, enlarged twenty-five diameters, and a female in figure 17, enlarged fourteen diameters. These true males and females pair, and the female soon deposit eggs, which completes the life cycle of this insect, the eggs remaining over winter, while all the other individuals perish.

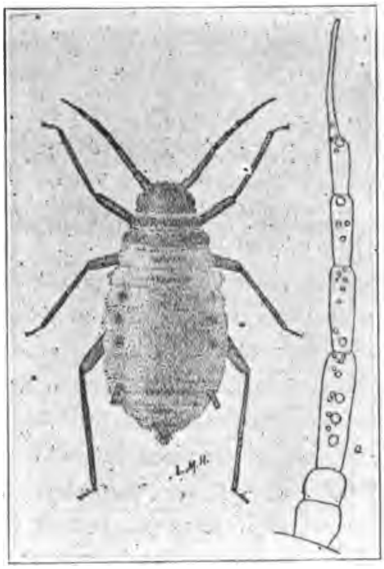


Fig. 16.—Corn-Root-Aphis, *Aphis maidiradicis*, male; enlarged twenty-five diameters; a, antenna.

It is an absolute fact that the corn-root-aphis depends entirely upon these small red ants for its existence. The aphids by themselves would not be able to move through the soil and seek the roots of their food plants. In fact, it has been demonstrated by experiments that these aphids will starve to death when left within an inch or two of the roots of their normal food plant. They must be carried by the ants and put upon the roots in order to survive. It is a fact, then, that if we can do away with the two species of common red ants, the corn-root-aphis would practically disappear. Hence, in suggesting remedies or preventive measures for these aphis, it becomes necessary to take into account first of all the ants.

It is a very rare thing, indeed, that a corn field becomes badly infested with the corn-root-aphis the first year following some other crop. It is, as a rule, old corn fields that have been continually in corn, or that have been in corn for at least three years, that suffer from these insects. Therefore, by a judicious rotation of the corn crop, one can very easily escape any serious trouble from these pests.

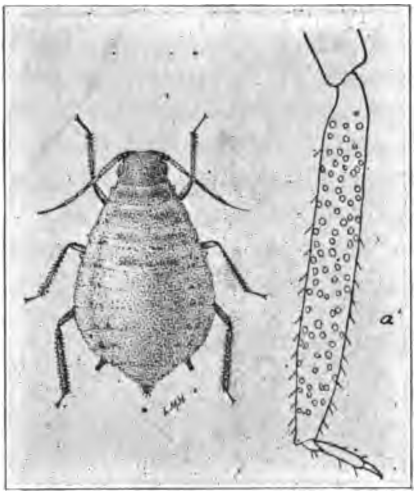


Fig. 17.—Corn-Root-Aphis, *Aphis maidiradicis*, oviparous female; enlarged fourteen diameters; a, hind tibia.

The corn-root-aphis depends upon the corn, smart-weed, foxtail or pigeon grass, or purslane, and will not survive to any considerable extent upon any other plant. Hence the raising of a crop which will prevent the growth of these plants will starve out the corn-root-aphis in spite of the attendance it must receive from the numerous small red ants that may be in the field. Fertilization of the field so as to help the plants to become thrifty and outgrow the attacks of these insects and to withstand drought better than otherwise, will also help them to escape the injury from these insects.

Next to rotation, however, thorough plowing and harrowing early in the spring of the field intended for corn and the disk harrowing of such a field at frequent intervals until the corn is planted, which corn may be delayed for sometime for this purpose, will prevent the growth of their food plants and will also practically clear a field from any injury from these insects. This is accomplished by plowing about eight inches in depth and then harrowing at frequent intervals thereafter, so as to throw up and disturb and scatter the ants nests, in the burrows and chambers of which are the little red ants and the eggs of the aphids. By throwing these eggs about through the soil and scatterings the eggs and ants, the eggs or aphids will, of course, perish unless the ants find them, and the ants are so demoralized and the eggs so scattered by this continued harrowing, that they are not able to find but a small per cent of the eggs of the aphids, or the aphids themselves, should they hatch, and the great bulk of the injury that would have followed is thereby prevented. Then again, this frequent harrowing will prevent the development of the smart-weed and fox-tail or pigeon grass, which will also do away with the food plants, on the roots of which the little red ants will place the aphids if they can find the aphids and the plants to do so. Good results will follow by delaying the planting of corn about two weeks later than one would normally put it in the ground, and during these two weeks harrow the field with the disk harrow at least twice.

NORTHERN CORN ROOT-WORM.

Diabrotica longicornis, Say.

The northern corn root-worm sometimes causes several million dollars' damage to corn by injuring the roots of the same, but its work is often largely mistaken for that of the wireworms and other root-feeding insects. The wireworms, however, do cause the greatest loss to the corn crop by root injury. Frequently corn in localities, especially in high, dry places, will not grow as fast as the corn in a neighboring area, and frequently such corn will be only six inches or a foot in height, when all about this infested area it will be four or five feet high. It also frequently happens that corn in infested localities of a field will fail to make ears at all or the ears will consist largely of nubbins. Then, again, corn in certain areas will fall down by an ordinary brisk rain or wind and remain there, failing to regain its upright position.

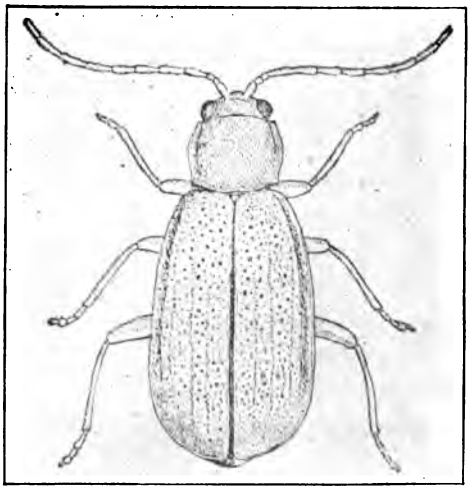


Fig. 18.—Northern Corn Root-Worm, *Diabrotica longicornis,* Adult Beetle; enlarged ten diameters.

With these symptoms one can mistrust the presence of the northern corn root-worm, but as the wireworm causes a similar effect, one can only readily know the presence of this northern corn root-worm by pulling up a few hills of corn and examining the roots. The wireworms eat off the roots and mine more or less through the lower part of the stalk, or, rather, the base of the roots, while the northern corn root-worm mines inside of the root itself and does not, at least as a rule, enter the base of the roots or the stalk at all.

In pulling up the hills infested with the northern corn root-worm, the roots will be found to be decayed, discolored, and especially the discolored roots will be found to contain a dark, irregular line, extending sometimes nearly the entire length of the root, which indicates the burrow of these insects. On cutting this open one will find this more or less filled with droppings, and the little larva can usually readily be found inside of it. The larvae usually eat the roots some distance from the stalk and mine up in an irregular direction toward the stalk. After killing the root the larva leaves it and seeks a fresh and healthy one, and soon destroys it also, and in this manner each larva will kill many roots, and as there are frequently fifteen or twenty larvae to a hill of corn, the damage is sometimes great.

The injury therefore that these insects do is by depriving the plant of proper nourishment by destroying the roots entirely, or by weakening them and thus preventing the plant from developing as fast as it should in the matter of growth, and preventing the proper development of the ear. In beetle-infested hills one will frequently find six or eight, or even twenty, of these larvae mining in the roots, and as soon as they have killed one root and caused it to rot away, they move to another, so that a few of these insects may practically keep the plant in check by mining in the roots as fast as they develop.

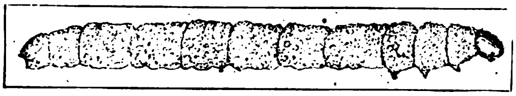


Fig. 19.—Northern Corn Root-Worm, Larva, enlarged six diameters.

One can also determine the presence of these insects in the corn by examining the worms or larvae themselves. They are white or light yellow larvae, about two-fifths of an inch in length and about as large around as a good-sized pin. The head is dark and there is a dark patch on the last segment of the body. One of these larvae is illustrated, magnified six diameters, in figure 19, and another one is shown in figure 20, partly protruding from a root which has been broken off.

The adult of the northern corn root-worm is a small beetle, shown enlarged ten diameters in figure 18. They resemble very much some of our squash beetles, and, in fact, are closely related to them. These northern corn root beetles are of a beautiful green color when they have fully matured, but when they first appear are of a decidedly yellowish color, the green appearing a little later.

These beetles feed upon the pollen of corn, especially where it collects between the leaves and the stalk, also upon the silk, and upon the pollen and more or less upon the petals of the flowers of common weeds found about the corn fields, and also upon the pollen and petals of clover and some other plants.

The beetles appear during the latter part of July and all of August and the fore part of September, and deposit their eggs an inch or two below ground in the corn fields. The beetle either crawls under clods of earth or buries itself in the ground for this purpose. So far as known, these insects do not deposit their eggs in any other situation, and it seems certain that this insect in the larval condition will not feed upon any other plant than corn. These facts should be borne in mind when we come to consider methods of fighting these insects. The eggs are deposited in a few weeks after the beetle emerges and the great bulk of the beetles, at least, die before the winter is past.

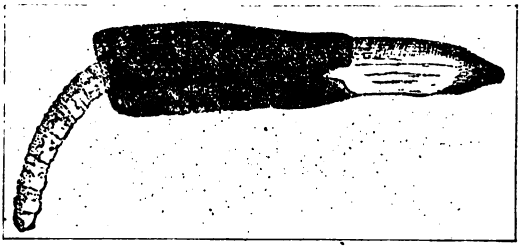


Fig. 20.—Corn Root broken off to show larva of Northern Corn Root-Worm within; enlarged.

The insects apparently pass the winter only in the egg stage, the eggs which are deposited in the corn field in the latter part of the summer remaining there during the winter and hatching the next spring, sometime after the corn begins to appear above ground. The larvae then move through the soil in search of the roots of corn upon which to feed. The eggs do not all hatch at the same time, but appear to vary a month or more, and hence we find young larvae extending through a period of four or five weeks. The larvae will be found about the roots of corn during June and July, and after becoming full grown, leave the roots, and a short distance from them transform to pupae in the soil usually within a couple of inches of the surface. These pupae may be found by pulling up the corn plant and shaking the dirt away from the roots during July and August. The adult beetles begin to appear during the latter part of July and continue to come out from the ground during August and the fore part of September, usually crawling up the corn stalk and feeding upon the pollen and silk. There is, therefore, but one brood of these insects each year. The adults also have been known to eat the tender parts of the leaves of the corn plant, but prefer the pollen and flowers.

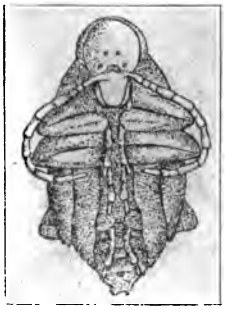


Fig. 21.—Northern Corn Root-Worm, Pupa; enlarged eight and one-half diameters.

It is almost invariably the case that these insects do damage only to fields that have been in corn for several years without rotation.

Where one rotates corn with grain or grass or other crops except sorghum and broom corn, these insects are held in check because of the fact that the larvae will not, so far as known, feed upon any other plant than corn. Hence when one finds the corn fields infested with these insects, all that is necessary to do in order to rid the field of their presence is to put the field in some other crop for a year or two and use another field for the production of corn in the meantime. This simple rotation of the corn crop every two or three years is all that is necessary to keep these insects within reasonable numbers.

THE SOUTHERN CORN ROOT-WORM.

Diabrotica 12-punctata, Oliv.

In the southern, especially the southeastern portion of Missouri, the roots of the corn plant are more liable to be attacked by a corn root-worm known as the southern corn root-worm. This insect in the adult condition is a small beetle, shown in figure 22, enlarged five and two-thirds diameters. It is frequently spoken of as the squash and cucumber beetle, and, in fact, is found upon these plants frequently in connection with the true squash and cucumber beetles, and is known to feed more or less upon these plants, as well as upon the fruit, into which it occasionally mines a short distance. These beetles lay their eggs in corn fields and the larvae mine through the larger roots to the crown, and also here and there through the crown or even the base of the stalk, differing in this respect in their habits from the northern corn root-worm, which is more commonly distributed over the larger part of Missouri. The complete life history of this beetle has never been worked up. The insects are more troublesome south of Missouri, and are not found in the northern half of our State.

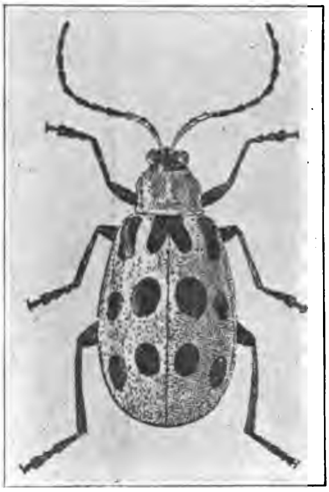


Fig. 22.—Southern Corn Root-Worm *Diabrotica 12 punctata*, Adult Beetle; enlarged five and two-thirds diameters.

The effect of the presence of these insects in the corn field is similar to that of the northern corn root-worm. However, we have

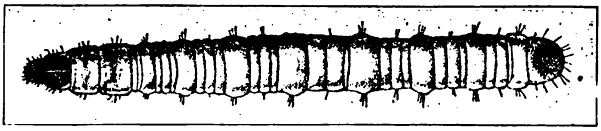


Fig. 23.—Southern Corn Root-Worm, Larva; enlarged five diameters.

no suitable means of fighting these insects as is the case with the northern corn root-worm, because the insect is not confined in its food habits to the corn plant by any means, and therefore cannot be starved out, as in the case with the other root-worm. The insect seems to attack more especially sugar corn and corn planted early, or corn in the neighborhood of squash, cucumber, melons and the like. An illustration of the larvae of the southern corn root-worm is shown in figure 23, enlarged five diameters, and a side view of the same in figure 24, also magnified five diameters. A pupa is shown in figure 25, enlarged ten diameters. Insects in the larval condition are frequently attacked by a bacterial parasitic disease, which kills great numbers of them. Apparently when these insects become unduly numerous, they succumb very rapidly to this disease, which seems to be the only means by which these insects are held in check materially.

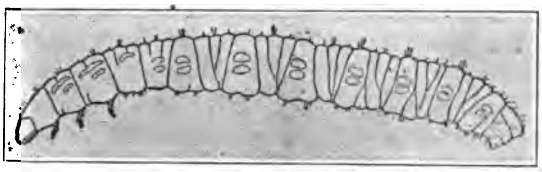


Fig. 24.—Southern Corn Root-Worm, Larva, lateral view.

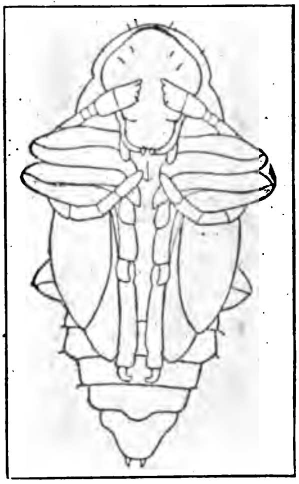


Fig. 25.—Southern Corn Root-Worm, Pupa; enlarged ten diameters.

THE WHITE GRUBS.

Lachnosterna (several species).

The common white grubs are among our most widespread and destructive insects infesting general farm crops, not only throughout this country, but in Europe as well. They are the larval stage of what are commonly known as May beetles or June beetles, and are familiar to town people as well as to farmers, because of the fact that the beetles are so readly attracted to light that they frequently get into our houses and fly about the rooms with a buzzing sound, bumping against the ceiling and the walls and finally tumbling down, recovering themselves and repeating the same process. These beetles, às everybody knows, are from one-half inch to three-fourths inch in length, of a robust form, the body being short and thick set and of a dark brown color. As they all have a very similar appearance, differing largely in the matter of size and the shade of brown, I have given an illustration of one species only, viz., *rugosa,* which is shown enlarged two and one-fifth diameters in figure 26. This will give the reader a good idea of the general shape of all of these beetles.

While we have a good many species of these May beetles or June beetles here in Missouri, nearly all of them belong to the genus *Lachnosterna.* Our most common species is *fusca,* but *gibbosa* is a close second; *hirtucla, fraterna* and *rugosa* are perhaps next in order. It will not be necessary to discuss a single species, but we will confine our remarks so as to include the life history and habits of the majority of these May beetles.

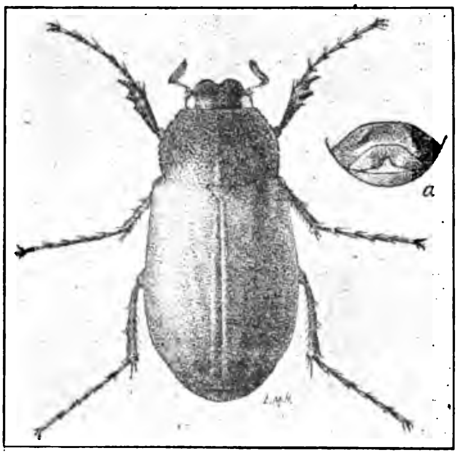


Fig. 26.—One of the White Grubs, *Lachnosterna rugosa,* Adult Beetle; enlarged two and one-fifth diameters.

The beetles, as you know, appear in the spring during May and June, sometimes coming forth in great numbers and flying about just at dusk, and continuing this during the night. At the approach of day they seek shelter under grass, clods of earth, or even enter the earth itself and remain there until sundown, when they come forth again to fly about and pair and feed upon the leaves of a great variety of forest, shade, ornamental and some fruit trees and bushes. The males seem to be in much greater abundance than the females, our collection last spring showing about five males to one female. This seems to be the case with all species of May beetles. The male beetles die soon after pairing, and the female beetles deposit their eggs within a month and then die. Hence it is that we find very few May beetles after June.

These beetles lay their eggs in the ground about the roots of all kinds of grass. The eggs are deposited singly, usually to the depth of a couple of inches, each female depositing between two hundred and two hundred and fifty eggs. The eggs hatch into larvae, which are known as white grub. These larvae feed upon the roots of grass of all species. They are of a light, dirty-white color, quite transparent, and of the form shown in figure 27, which represents one enlarged two and one-half diameters. Everybody is familiar with these white grub, as they are to be dug up in our home gardens as well as throughout the general farm. Besides feeding on the roots of grasses these insects also feed upon the roots of a great variety of other plants, including practically all of our staple farm products, as well as garden vegetables, and are among our most destructive insects in strawberry patches. They also feed upon the roots of young trees.

These grub may be so numerous in sod land that a single cubic foot of earth will contain a dozen or more of them. However, one rarely notices the presence of these grub in the pasture or grass field except under certain climatic conditions, as would occur when a severe drought appears. The damage, however, exists, but is not taken into account largely because we are accustomed to great loss in grass fields by these insects. It is when the grass field is plowed and sown to corn or other grains that we notice the serious damage from these white grub. They are deprived to a large extent of their abundant supply of food, and we have substituted in its place a comparatively small amount of food in the shape of corn plants. The white grub then begin to feed upon the roots of the corn plant soon after it germinates, and by eating off the tap root in the beginning, and ultimately all the roots, they seriously hamper the growth of the young corn plant, making a stunted, unhealthy stalk, which will either not properly mature an ear of corn, or will kill it outright, as the case may be, sometimes killing the plants before they are a foot high; at other times injuring them so that they will grow to a nearly normal condition but will not make the proper amount of corn.

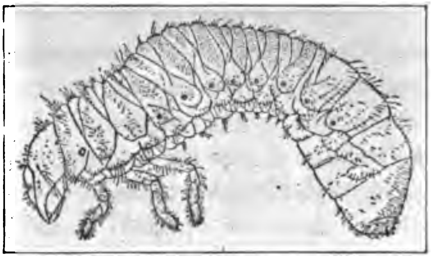


Fig. 27.—One of the White Grubs, *Lachnosterna rugosa*, Larva or Grub; enlarged two and one-half diameters.

One serious drawback to the presence of these white grub feeding upon the roots of corn is that they prevent the roots from growing down deep enough into the ground to get moisture during the dry weather, and hence the plants shrivel and die, or are greatly injured. By feeding upon the roots, they also prevent the corn plant from sending out the proper anchor roots, and hence the plants blow over with an ordinary stiff wind and do not regain their upright position.

These white grub, after feeding upon the roots of various plants during the summer and growing slowly all the time, at the approach of cold weather burrow deeply into the ground, sometimes going a foot and a half or so in depth and there remain quietly hibernating during the winter, beyond the reach of ordinary freezing in this locality. The following spring these grub revive and work their way up toward the surface, where they begin again to feed upon the roots of the various plants that they are accustomed to. They thus feed another summer, and at the approach of cold weather hibernate again, as before indicated. The next spring they come up near the surface, feed for a time and then, along in the early part of the summer or latter part of the spring, pack the earth away from their bodies so as to make a little earthen cell, and there, a few inches below the surface, they transform to pupae. This pupa stage lasts until the latter part of July or fore part of August, when they transform to adults. These adults now almost invariably remain in the ground inside of their little earthen cells throughout the rest of the slummer, fall and winter, and emerge as adult beetles the following May or June. This brief sketch of the life history does not apply to all species in that some of them take five years to go through their transformations, so that we have in the various species of May beetles variations in the time for the transformation extending from two to five years, the great majority, however, requiring three years to complete their life cycle.

The white grub do their greatest amount of damage to corn that has recently followed grass. It is a fact, however, that these beetles will lay their eggs year after year in a corn field, and the insects can multiply there, but the most prevalent method is for the insects to deposit their eggs in the grass field, and for the farmer to plow these grass fields and sow them to corn, in which case we have a greatly increased number of white grub in a given portion of soil than we would have under the best of conditions were the insect trying to multiply year after year in the corn field. Hence newly plowed grass land will be subject to the attack of these insects for upwards of two or three years following. Very frequently such fields will contain from four to twelve white grub at every hill of corn, and under these conditions one can readily see that the raising of corn would be very unsatisfactory. These insects do not feed to any great extent upon clover, and, therefore, in rotating the crop from corn to pasture, if one would sow the same to clover, it could remain as a clover field for several years and then be replanted to corn without any serious injury from these insects, whereas, if the corn were rotated with grass, very serious trouble would be likely to follow.

The May beetles are much more apt to lay their eggs in corn fields if the same contain any considerable amount of grass or weeds during May and June, during which time these insects are depositing their eggs. As these white grub will feed upon wheat, barley, potatoes, beans and the like, it will not suffice to try and rotate a beetle-infested field with these crops any more than with grass. Where one turns under some land and sows it to corn and finds these white grub extremely numerous, it would be much more satisfactory to not replant the corn again, but to sow the field to clover and let it stay in clover for a year or two.

As common and widespread and as injurious as these white grub are, they are among our most unsatisfactory insects to combat, and we do not yet know of any first class and satisfactory method of dealing with it. We cannot kill them in the ground by any of our ordinary farm methods. We must resort very largely to starving the insects out of a field by not allowing them to have access to the proper amount of food plants. A good deal of good, however, can be done by turning hogs into the field during the spring, summer and fall, but no benefit can be derived whatever from this procedure by turning the hogs in during the winter, as the white grub are then found far below the reach of these animals. It is well known that hogs are very fond of white grub, not only as white grub, but as pupae and adults, and will root about the roots of grass and other plants in search of these insects and feed upon them. It is also a good plan to allow hogs to follow the plow when turning sod land. Good results have also followed the method of trying to capture the adult beetles.

It is well known that these insects will fly early in the evening to various trees in order to pair and feed upon the leaves, and by jarring these trees many May beetles may be gathered on a sheet and thus destroyed. But this should be done when the beetles first appear in the spring, as, if one delays this procedure, the beetles will be continually laying their eggs and may have finished before the work of capturing the beetles is undertaken.

There seems to be a widespread opinion that trap lanterns of various kinds are effectual methods of capturing May and June beetles, and that a great deal of good can be done by putting trap lanterns through the fields or other convenient places. This, however, is not so. The deception comes from the fact that a great many beetles are thus captured, but on examining these beetles one finds that they are practically all males, and that the few females that are taken have nearly all deposited their eggs. Last spring we ran trap lanterns, and I will give you briefly the capture from one trap lantern, which will serve as an illustration on this point. In fourteen days continuous running of the trap we captured 286 males and only 12 females of *fusca*, and 811 males of *gibbosa* and only 16 females. Hence one can readily see that the use of trap lanterns for lessening these insects is of no practical value whatever, as the insects deposit their eggs in spite of the trap lanterns.

The best method of fighting these insects is for the people in a neighborhood to turn their efforts to lessening the numbers of these beetles early in spring, when they first appear, by capturing them in sheets, as above suggested, and also by the methods of farm procedure which I gave above.

THE SOD WEB-WORMS.

Crambus (several species).

There are about sixty species of the sod web-worms in the United States, only four of which are commonly found infesting corn, viz., *Crambus trisectus* Walk., *C. mutabilis* Clem., both of which are two-brooded, and *C. luteolellus* Clem., and *C. vulgivagellus* Clem., both of which are single-brooded. We will discuss the sod web-worms together and not separately then, further than I have just given in regard to broods. Outside of the variation in the number of broods among the different species, their work, life history and habits are so similar that it will not be necessary to discuss the separate species independently.

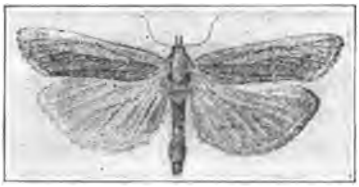


Fig. 28.—The Common Sod Web-Worm, *Crambus trisectus*, Adult Moth; enlarged about two diameters.

These sod web-worms infest grass lands of all kinds, and this is their principal and normal food. They are to be found every summer in considerable numbers not only in the grass fields but in our lawns, and the amount of damage that these insects do every year is not taken into account, as a rule, simply because of the fact that we are so accustomed to a loss of upwards of ten per cent of the grass crop by the ravages of these insects that we do not now notice them unless, as sometimes happens, they become unduly numerous in certain areas, in which case they may ruin the entire field of grass or the lawn, so that the same appears withered and dead and can be burned over when it should be perfectly green and healthy. This annual loss of about ten per cent of the grass would amount to many millions of dollars in the aggregate, taking the entire United States over. This will give the reader some idea of what is continually going on in the matter of the destruction of various products by comparatively obscure insects, when the same is done under what we might call normal conditions prevailing from year to year. The sod web-worms do not, as a rule, injure the corn crop unless this corn follows on land which has been in sod the year previous, and as a rule, for several years before turning it under in preparation for the corn crop. In this case they may ruin the young corn and make the second and even a third replanting necessary.

The work of the sod web-worm in the corn is very frequently mistaken for that of the army-worm and the various species of cut worms. Indeed, at times the work of these sod web-worms does resemble the work of some of the cut worms hereinafter described. However, with a little care in searching for the larvae, one can very readily tell definitely whether the work is due to these insects or not.

The sod web-worms are the larvae of the little white or gray colored moths that one finds so commonly flying up before him as he walks through the grass fields during the summer. These moths will fly a short distance ahead or to the side and alight again upon the grass, usually with their heads downward; and when they alight, they fold their wings about their bodies, so as to give them a long, cylindrical appearance, and except for their color, rather difficult objects to find on account of the fact that that they keep the body close to and parallel with the blade or stem of the grass on which they alight. Two species of these moths with their wings expanded are shown enlarged in figures 28 and 30.

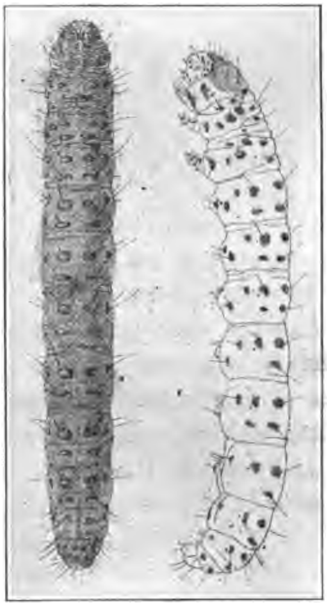


Fig. 29.—The Common Sod Web-Worm, *Crambus trisectus*, Larvae; greatly enlarged.

These moths lay their eggs here and there over the grass fields, including our lawns, the most of them being deposited in June and July. The eggs hatch in about two weeks, and the larvae, which are known as the sod web-worms, burrow into the ground near the base of the grass plant, and feed upon the stem and the leaves surrounding it just below the surface, and also upon the roots at the base, sometimes cutting them entirely in two. They also burrow into the stem and frequently make tunnels or mines up the center of the stem, or along the edge, thus causing irregular furrows. They will also feed upon the leaves, eating longitudinal, irregular holes through them, frequently cutting off the leaves near the base partly drawing them into their burrows or cells, which they construct at the base of the plant.

The larvae, as soon as they hatch and begin to feed, begin to construct for themselves a little cell, usually near the surface of the ground and in close contact with the stem of the grass plant or the corn plant, as the case may be, and make these cells out of silk, weaving with it particles of the earth, and then line it with a thick layer of silk. As the larvae grow, they enlarge these cells. Figure 32 represents a corn plant much reduced in size with one of these cells placed in the usual position next the plant and just below the surface of the ground. The end of the cell next to the plant is left open, so that the larva can go forth in search of its food and return when necessary. Frequently during the daytime, one searching for these insects will find pieces of grass leaves or even corn leaves with one end pulled into the open end of these cases, and inside the larvae quietly feeding upon it.

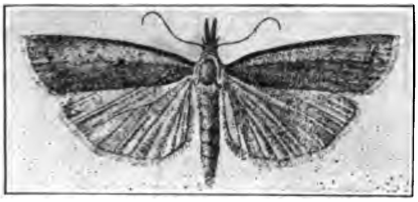


Fig. 30.—The Striped Sod Web-Worm, *Crambus mutabilis*, Adult Moth; enlarged about two diameters.

When full grown these sod web-worms are about one-half inch in length and are of a red or reddish brown color, with many dark, conspicuous, shiny spots scattered over their bodies, each one bearing a rather stout hair. The work of these insects in the corn plant is similar to what I have described for the grass plant, except that where a corn field is very badly infested with the insects, we frequently find several of these larvae eating each plant in the badly infested areas. Occasionally they become so numerous in the corn field as to practically devour the entire corn plant, but this is unusual. In the great bulk of cases the larvae injure the plant and kill it by eating about the base of the roots and cutting the roots in two, or more frequently by eating off the young leaves and the stem, or feeding on the stem below ground or sometimes above it, as the case may be. In going through the corn fields infested with these insects, one will frequently find leaves or parts of leaves cut off and some of which will be found protruding from the larvae cases above described.

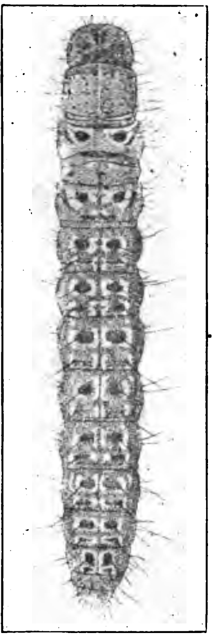


Fig. 31.—The Striped Sod Web-Worm, *Crambus mutabilis*, Larva; greatly enlarged.

Of course, the work that these insects do in the grass lands continues throughout the summer, since we have some species with two broods, which follow each other so closely that the work is practically continuous. In the corn field, however, the damage that these insects do is confined entirely, or nearly so at least, to the young corn plants. When the larvae become full grown, they may enter the cases in order to pupate, or they may leave them and enter the ground a short distance and transform to pupae without the protection of the cases or cocoons. When the adults appear they soon lay their eggs for a second brood, provided the particular species has a second brood.

The sod web-worms all pass the winter as hibernating, partially grown, larvae, which may be found inside of the webs or cases next to the base or stems of the infested plants, the case being stopped up at the upper end by silk thread and the inside lined with more silk. At the approach of warm weather these larvae revive and come forth to feed upon the grass or the corn plant, as the case may be.

While most species of cut worms cut the corn plant down in the spring of the year by eating it off near the surface of the ground, the sod web-worms rarely ever cut a plant down, but feed upon it and kill it as above described. When one finds the sod web-worm, they can be distinguished from cutworms by the fact that when disturbed they will try to get away as rapidly as possible, while a cutworm when disturbed will curl up and remain sluggish. But of course the corn grower can, by looking about the base of the corn plants, find the webs or cells of these insects and usually find the larvae in them, in which case he can readily determine the cause of the injury. By even pulling up the young corn plants the case can be readily found.

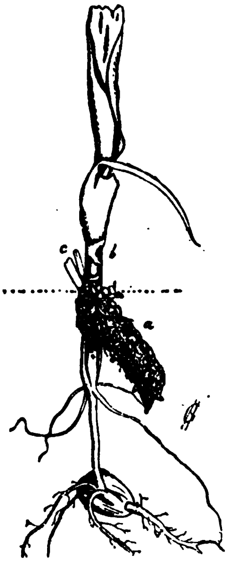


Fig. 32.—The Sod Web-worm (*Crambus*): web (*a*) containing larva, at base of young corn plant; *b*, *c*, injuries to leaf and stem.

The sod web-worms, like our cutworms, prefer to feed at night, but will also feed on dark days, usually passing the daytime inside of their tubes, which tubes, when they contain full grown larvae, are usually from one and one-half to two inches long and about one-half inch in width. Two species of the sod web-worms in the larval condition are shown enlarged in figures 29 and 31.

The methods of fighting the sod web-worms are very similar to those described for cutworms, the difference being mainly in the time of the application of the methods of procedure. Sod land that is badly infested with these insects should be plowed in the early part of September, if the field is intended for corn the next year, or if it is not plowed in the fall, it should be plowed the last of May. Plowing of the field the first of September will prevent the adult moths from depositing their eggs in that field, as they will then seek a grass field that has not been plowed under, in order to deposit their eggs for the brood which hibernates in a partly grown larval condition during the winter; or, by plowing the land in May, and sowing to corn soon after, one will escape the larvae of the first summer brood. We cannot poison these insects by any of the means used for cutworms, as they do not seem to feed upon those substances, although they do crawl about the ground from plant to plant.

THE DINGY CUTWORM.

Feltia subgothica, Haworth.

We have in Missouri a great many species of cutworms, and while at certain times numbers of these different species may infest the corn, as well as other farm and garden crops, nevertheless, six species are usually the ones found doing the most damage to corn. Of these the dingy cutworm is the most important.

Like all cutworm moths, the adults of the dingy cutworm are unattractive and inconspicuously colored. They are about an inch and a quarter across their expanded wings, and the general color of the fore wings is a smoky-gray. By referring to figure 33, one can obtain a good idea of the size and appearance of these adult cutworm moths. Like most of the other members of this family, the moths are nocturnal in their habits, and during the day remain concealed in sheltered places upon the bark and twigs of trees, bushes and fences, etc., and fly about after sundown in search of sweets, and for the purpose of mating and laying their eggs. They are readily attracted to light and will for that reason frequently come into our open windows during the evening.

The moths appear during August and the fore part of September, and begin to lay their eggs during the latter part of August or the fore part of September, not long after they have emerged. The eggs are deposited in clusters upon the stems and leaves of various trees and bushes, in the neighborhood of which there is plenty of food in the form of various weeds and grasses, also upon the stems of shrubs and weeds and sometimes upon stones.

These eggs hatch in about ten days, and the young larvae soon crawl to the nearby plants, upon which they feed in case they are not born upon suitable plants, and some of them may feed for a very short time upon the leaves of trees and bushes upon which they are born, but very soon crawl down or drop down to the ground and seek various weeds and grasses, feeding there upon their leaves. These larvae are not at all particular about what kind of plants they feed upon, but will be found feeding upon almost any green succulent plants, whether they be various weeds and grasses, or other uncultivated or cultivated plants. They are usually unnoticed by the agriculturist at this time, and when the cold weather approaches they seek some sheltered place in which to hibernate, doing so under stones, under a quantity of leaves, or, as a rule, enter the ground a little ways at the base of the plants upon which they have been feeding, and there hibernate during the winter as partially grown larvae.

In the spring, when settled weather appears, these larvae come out from their winter quarters, and during the night crawl about in search

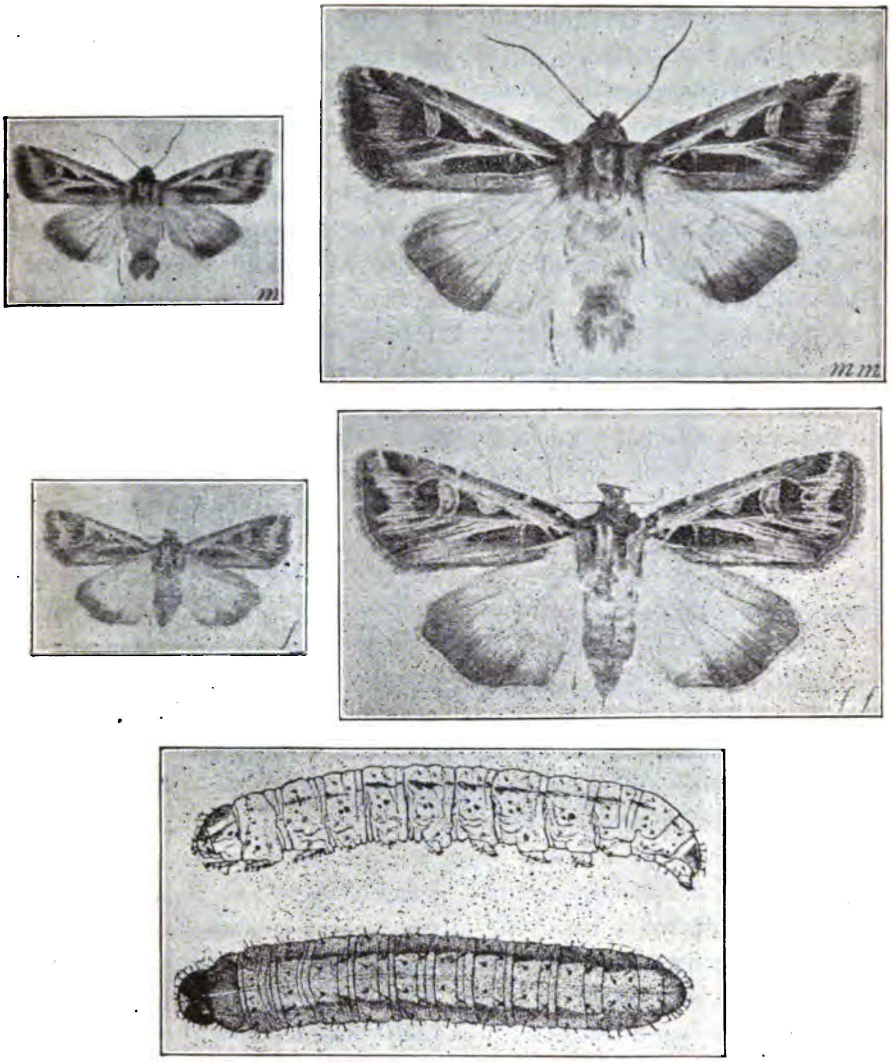


Fig. 33.—The Dingy Cutworm, *Feltia subgothica*: *m*, and *f*, male and female moths, natural size; *mm*, and *ff*, male and female moths, twice natural size; larvae, side and back views, twice natural size, at lower part of plate. (From Slingerland.)

of some green vegetable substance upon which they may feed. They are now even less particular in their choice of food plants than they were when younger, and will attack not only all the various garden and farm crops, including corn, but will attack various grasses, weeds and other uncultivated plants and will get into the garden vegetables and feed upon sweet potatoes, strawberries and the like.

During the daytime they hide under rubbish of all kind or under stones, or bury themselves a little ways in the ground, sometimes trying to carry part of the way with them pieces of the plants upon which they have been feeding, evidently with the intention of feeding there out of sight during the daytime. In the evening they come forth again and feed in their characteristic manner, doing more or less mischief according to the plant upon which they are feeding and according to the numbers in which they appear.

At this season of the year these insects have a peculiar habit of eating through and cutting down, just above the surface of the ground, the various small and succulent plants, like wheat and corn. They thus feed and gorge themselves, rarely remaining at the same plant until they have partaken of sufficient food, but pass on to other plants and cut them down in like manner. At this stage of the larva, which is now nearly full grown, the creature appears as a fat, smooth larva, of about an inch and a quarter to an inch and a half in length, with a wide gray stripe down the back, and a dusky or dingy-gray along the sides. The head is dark brown in color, and there is also a dark-brown area on the back of the tail-end of the worm. The spiracles or breathing pores are black. A good idea of the appearance of these larvae may be had by observing the two enlarged ones in figure 33.

The amount of food that these larvae now consume during the night is amazing. They gorge themselves until they appear ready to burst, and the damage they do when in sufficient numbers in a corn field is considerable, because of the fact that they cut down so much more corn than they eat. The same rule applies to their habits in a wheat field or in the vegetable garden.

During June these larvae enter the ground about two inches and soon change to mahogany-colored pupae. They now remain here in the pupae stage for a long time in comparison with the summer pupa stage of most insects, for they do not change to adults until August and the forepart of September. It will thus be seen that with this dingy cutworm there is but one generation each year, and that the damage the insect does occurs in the late spring and early summer, from the time the larvae come out from their hibernating quarters until the time they enter the ground to pupate.

Since the parasitic and predaceous enemies of this insect and the methods to be used to control it are similar to those for most other cutworms, we will defer the discussion of these points until we have discussed one other cutworm. (See under variegated cutworm.)

THE VARIEGATED CUTWORM.

Peridroma saucia, Hubner.

This variegated cutworm is equally as common as the dingy cutworm in the State of Missouri. Sometimes one and sometimes the other appears to be the most numerous in the corn fields whenever they occur in sufficient quantities to attract attention.

The adult moth of the variegated cutworm is somewhat larger than the preceding species, it being about one and three-quarters of an inch across its expanded wings. It is likewise an inconspicuously colored moth, the front wings being of a dull grayish-brown, tinged with reddish, and with a darker margin. The hind wings are of a pearly-white color, with the margins tinged light-brown, as are also the principal veins.

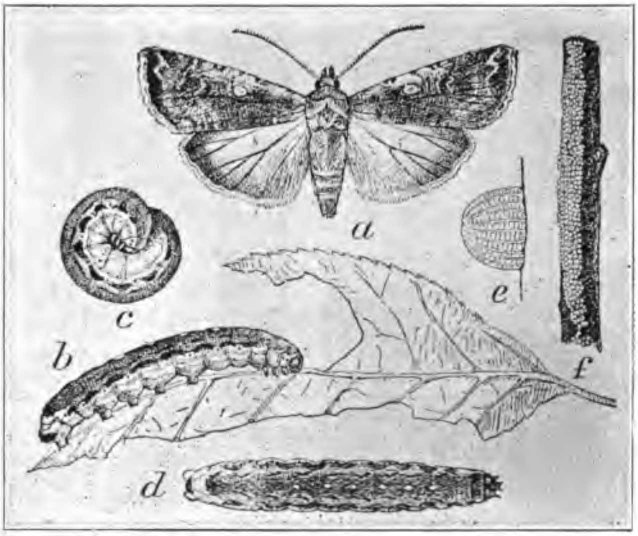


Fig. 34.—The Variegated Cutworm, *Peridroma saucia; a,* adult moth, natural size; *b,* normal larva, natural size; *c,* same in curved position; *d,* dark colored larva, dorsal view; *e,* egg, greatly enlarged; *f,* egg mass on twig, natural size. (From Howard, U. S. Dept. Agric.)

A better idea of these adult moths can be had by observing figures 34, *a*, and 35, *c*, and *d*—*b* and *c* are natural size. This color, however, varies considerably with the different individuals, the species being quite variable in the adult condition as well as in the larval stage.

These moths are likewise nocturnal in their habits, seeking sheltered places, such as the bark of trees and about rail fences, where they remain during the day, and, like the preceding species, are rarely noticed by the ordinary observer unless they should happen to take flight, which, by the way, they do not readily do at this time. Their color so closely resembles that of the object upon which they are resting, that they escape not only the notice of persons, but, undoubtedly, are more or less protected thereby from the attack of predaceous animals like birds that may perhaps feed upon them.

Most entomologists writing upon this subject seem to think that this insect has two and perhaps three broods each year, but my observations in this State lead me to believe that the insect is only single-brooded, in Missouri at least. I have never been able to find good reasons for believing otherwise.

The adult moths are to be found throughout the greater part of the

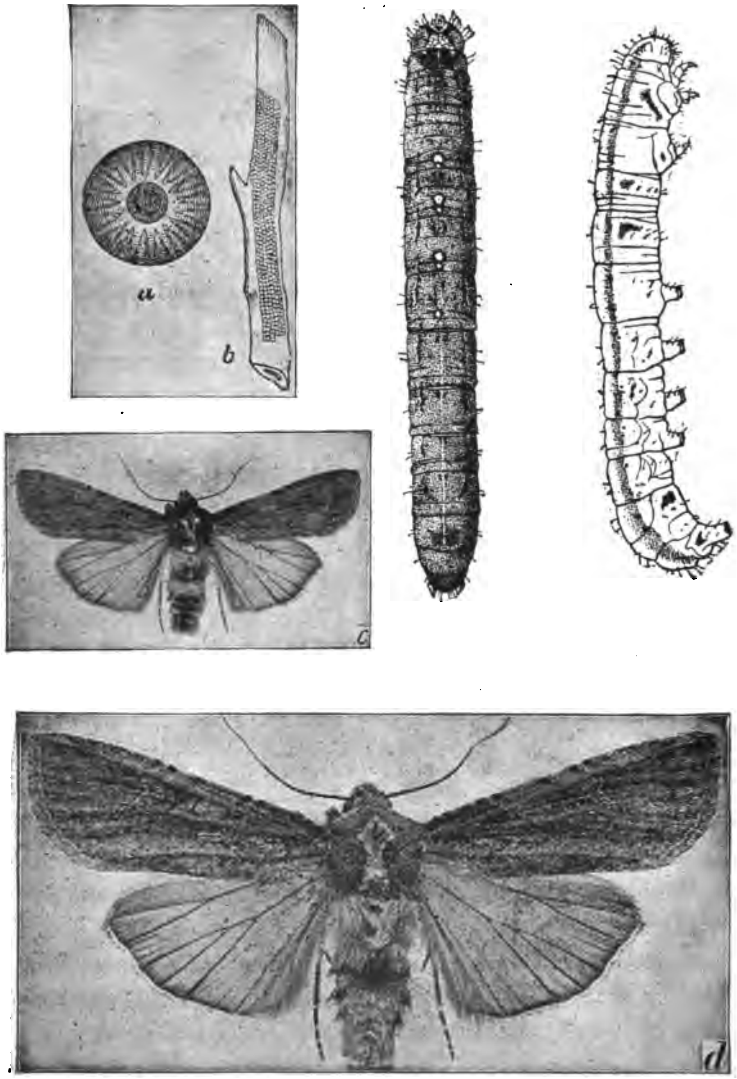


Fig. 35.—The Variegated Cutworm, *Peridroma saucia; a,* an egg, greatly enlarged; *b,* cluster of eggs, natural size; *c,* adult moth, natural size; *d,* adult, twice natural size; the larvae, twice their natural size, in upper right hand corner of plate. (From Slingerland.)

spring, summer and fall, but these are, no doubt, from the same brood, the moths themselves living for a long time. So far as my observations go, it appears that these insects hibernate as adults during winter, and come forth early in the spring as soon as warm weather appears, and lay eggs upon the stems and twigs of various trees and shrubs, frequently in orchards, especially where these orchards have become more or less grown up with weeds and grasses, and also laying eggs upon the leaves and stems of weeds.

The eggs are found in large masses. Each egg is semi-spherical in shape and beautifully ribbed and marked as can be seen by referring to figures 34, *e,* and 35, *a,* which represents these eggs greatly magnified. In 34, *f,* and 35, *b,* we have a cluster of these eggs upon a twig, shown natural size. The eggs hatch in about fifteen days.

The young larvae appear during the latter half of March and the first half of April. They feed at first upon the egg shells from which they have been hatched and then attack the leaves of the plant upon which they have been born and feed there for a short time. They then either crawl or drop down to the ground, leaving the trees and shrubs, and then feed upon the leaves of the various grasses and weeds near at hand. By May these larvae have become from half to two-thirds grown, and they then assume the characteristic cutworm habit of cutting down various succulent plants. These insects are likewise general feeders, and attack almost any green vegetable substance found in the uncultivated fields in the form of grass or weeds, or in our cultivated fields on corn, wheat, timothy, alfalfa and clover, and in the garden upon almost any vegetable that may be growing there, even relishing tobacco and onions, and attacking berries, squashes, potatoes and the like. During the latter third of the development of these larval cutworms, which usually occurs during the month of May, these creatures do an immense amount of damage to garden crops and also to corn and wheat.

When the larva are full grown they measure about an inch and three-fourths in length. They are also fat looking worms, of a dark, dull, brown color, sometimes with a greenish tinge, and are faintly mottled with gray and dark along their backs; while along the ventral surface they are much lighter in color. The head is of a reddish yellow color. These larvae differ considerably in their general appearance. The light form is shown natural size in figure 34, *b*, and a darker form at *d*. Two larvae, twice natural size, are shown in figure 35. When disturbed these worms curl up as shown in figure 34, *c*.

Occasionally when these cutworms, and also the preceding cutworms, occur in vast numbers over a comparatively small area, they may tend to migrate more or less or at least scatter about in search of food.

Usually about the forepart of June these larvae become full grown and then enter the ground, wriggling their bodies until they have packed the earth away and formed a little cell, and then transform to pupae. This pupa stage lasts from two to three weeks. The adults emerge during the latter part of June and the fore part of July.

The fact that these adults appear so early in the summer has undoubtedly led many writers to suppose that they now soon lay eggs for a second brood, yet no one has been able to demonstrate the presence of such a brood; and there are reasons, which I will not take the time to discuss, which lead me to believe that the so-called second brood does not occur, at least in Missouri, but that these moths now live until cold weather approaches, and then seek sheltered places under loose bark of trees, under logs and in protected rubbish, and there hibernate during winter, coming out early the next spring in order to deposit their eggs. We have, however, some species of cutworms which are known to be double-brooded.

NATURAL ENEMIES.

Both the dingy and the variegated cutworms are preyed upon, sometimes greedily, by certain birds. Fowls of all kinds devour them readily; crows, blackbirds, robins and bluejays are known to feed upon them; certain species of wasps likewise make use of them, and some ground beetles in both the adult and larval stages likewise feed upon them; but above all, the parasitic insects are the great enemies of the cutworms. Especially is this the case with at least two species of flies belonging to the sub-family Tachininae, and known as Tachinia flies.

These insects one of which is illustrated in figure 61, persistently lay their eggs upon the bodies of the cutworm larvae; and the young grubs hatching eat their way through the skin and feed upon the tissues of the larvae, reducing them and weakening them to such an extent that, should they even be able to make pupae, they will never be able to transform to adults. One instance is recorded where cutworms appeared in such immense numbers that they were ruining a clover field, and upon close observation it was found that ninety per cent of these worms were infested with these parasitic flies, and probably not more than one per cent of the larvae in that field ever reached maturity on that account. There are several species of Ichneumon flies that also greatly devastate the ranks of these worms.

REMEDIES.

The means and methods to be taken looking to the control of cutworms and the protection of certain crops from their ravages are similar, regardless of whether we are dealing with the dingy cutworm, the variegated cutworm or any of the other species hereinafter described. It is well known that the fields that have been in meadows for two or more years, and are then plowed up and sown to corn or other crops, are much more liable to be injured by cutworms than are fields which have been cultivated for the past two or three years, or even for the past year. Meadows and pastures are very apt to become infested with cutworms in a year or two. While these insects may not attract any special attention in such places, because of the fact that there exists a great many plants in proportion to the number of worms, yet, when such fields are plowed up and a cultivated crop sown to take the place of the other, these cutworms, deprived of the great bulk of their food, and the number of the substituted plants in the field many times reduced, become thereby proportionately greater in numbers. Hence it is that when these cutworms feed their injury becomes apparent; and in the case of corn, this is still more true than it is with wheat.

It is no uncommon occurrence to have to plant corn two and three times before one can get a stand, on account of the presence of cutworms; and in the case of wheat fields, it is not uncommon for large areas to be completely cut down by these creatures. It is not my intention in this connection to enter into a discussion of the work or the methods of fighting the cutworms in garden vegetables or such field plants as tobacco, potatoes, etc., and hence the methods here suggested are to be regarded as applying only to corn, and incidentally to wheat.

It is advisable to plow the meadow in which wheat or corn is to be planted just as early in the spring as possible, so that the cutworms will be deprived of their natural food in the form of grasses and weeds, and when they come out in search of suitable plants will be forced to abandon the plowed fields and seek other places where a supply of food can be obtained. This applies likewise to the fall sowing of wheat. If these intended wheat fields are plowed early, the larvae there will be likewise forced to abandon those fields, so that by the time the corn or wheat is up, the cutworms will not be found, at least not in sufficient quantities to cause any alarm. The practice, so general in many localities, of plowing the wheat field and sowing it to corn, and later of plowing a corn field and sowing it to wheat, is not especially favorable to the destruction of cutworms, because of the fact that the various weeds and grasses are growing in the field intermediate between the time the corn is unfit for their food until the sowing of wheat; and as this comes up soon, the insects are not deprived for any great length of time from finding sufficient food to sustain them in that particular locality, and hence they attack alternately the wheat and the corn plant, as these two are usually rotated. However, these alternate rotations of wheat and corn in the same field from year to year are much better from the cutworm standpoint than allowing the wheat or corn field to grow up to grass, clover or weeds for a year or two and then to plow it up in the hopes of raising wheat or corn free from the attacks of cutworms.

Perhaps the best direct way of fighting cutworms is the following, which I have advised for a number of years, and which has almost invariably given good results: The corn or wheat field may have certain areas, well known to the owner, in which the cutworms are more abundant and destructive. In such cases it will not be necessary to apply this method throughout the entire field. In other instances the field may be so situated as to suffer more or less along the sides bordering a meadow, especially a newly plowed meadow, infested with these worms, which would then tend to leave the newly plowed meadow and migrate to the wheat or the corn. In such cases, it would be especially advisable to apply the following method along that portion of the field which we wish to protect:

The method I have reference to is what is known as the poisoned bran method. A bushel of bran and one pound of pure Paris green, or a half pound of pure powdered arsenic, are to be stirred up thoroughly together while dry, and then some sweetened water is to be added in sufficient quantities to make a thick dough. If one needs to use a large quantity, and can get glucose, it will be found to be much cheaper than molasses or sugar for the purpose of sweetening this water. It is well to use a fairly good quantity of this sweetening substance, because it will tend to hold the particles of bran together, so that in drying it will not fall apart and become lost, as it will if the sweetening substance is not used. This poisoned bran is then to be scattered along in rows, through and around the field to be protected, or in which the cutworms are to be killed. In the case of corn, this poisoned bran should be placed there before the corn comes up, and in the case of spring wheat, it should be placed there just as soon as warm weather appears, so as to kill the cutworms before they have had time to injure the wheat. Cutworms will feed readily upon this poisoned bran and be killed, and in some instances they seem to prefer this bran to the plants. Of course, it is necessary to see that the poultry and livestock are not allowed access to such fields while the poisoned bran is there. In case one does not wish to or cannot readily use bran, a clover field or hay field may be sprinkled or sprayed with Paris green in the proportion of one pound of Paris green to one hundred gallons of water, and as soon as this has dried, the sprayed portion should be mowed and the clover or hay scattered in little clumps about the field to be protected. From experience, however, I cannot advise the use of these poisoned plants where it is possible to obtain bran.

THE GREASY CUTWORM.

Agrotis ypsilon, Rott.

The greasy cutworm ranks about third in importance among the various cutworms infesting the corn. It is a widely distributed and very common cutworm throughout the greater part of the entire world, and infests practically all of our farm and garden crops, as well as some fruit. The insects do not, however, have the extreme ups and downs occurring in certain years in undue numbers and in other years scarcely to be found, as is the case with some of our other cutworms. Its presence seems to be more uniform. In the full grown larval condition it measures about one and one-half inches in length and is of a greasy, dark gray color above and of a greenish yellow color below. Figure 37 gives a good idea of the general appearance of these cutworms somewhat enlarged. The adult cutworm is shown natural size in figure 36.

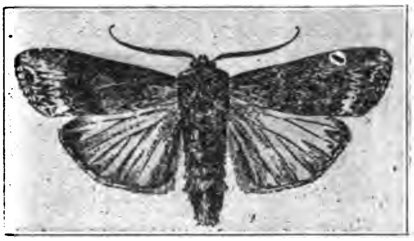


Fig. 36.—The Greasy Cutworm, *Agrotis ypsilon*, Adult Moth; natural size.

These larvae do the greatest amount of damage to the corn plants as well as to garden vegetables during the month of May and the early part of June. Like most of our other cutworms, the larvae hibernate in the ground during winter and come out in the spring in search of green plants to cut down and devour sufficient only for the purpose, however, of falling them. As soon as these larvae become full grown they enter the ground a short distance and transform to pupae, emerging as adults from the latter part of May throughout the month of June. These variations in the time of appearance of the adults is due to the fact that there is considerable variation in the time of depositing the eggs and of the maturing of the larvae. The moths lay their eggs during the entire month of July, and also to a certain extent in August, and the larvae feed upon the roots of grass, especially since the adults prefer to seek the grass fields in order to deposit their eggs. These greasy cutworms are more apt to injure the corn plants by cutting them down near the surface of the ground in the spring, so that late sowing of the corn or the second replanting of the corn thus injured does not tend to escape these insects, as is the case with certain other cutworms.

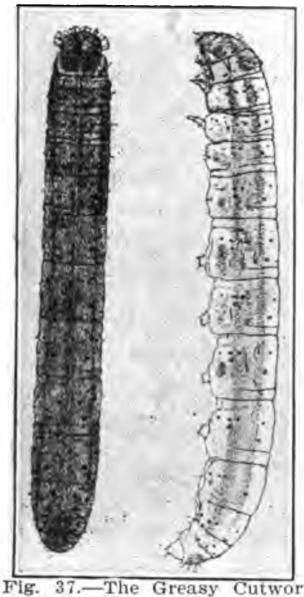


Fig. 37.—The Greasy Cutworm *Agrotis ypsilon*, Larvae, back and side views; enlarged.

The greasy cutworm has similar habits and life history to those which we have indicated under the discussions of preceding cutworms. The larvae, as soon as they hatch, feed upon the roots of grass and do no particular harm and attract no particular attention until cold weather, when they hibernate in those situations, and the next spring, as soon as they revive, seek the surface of the earth at night in order to crawl about and cut down the various plants upon which they feed. They thus cause their depredations until they are full grown larvae and transform to pupae.

These cutworms are all held in check to a certain extent by certain parasitic flies and parasitic hymenoptera, both of which have been discussed at some length under the variegated cutworm. The methods of fighting these cutworms are similar to those given under the variegated cutworm, except that the late fall plowing of the grass field previous to putting in corn does not seem to check these insects as much as it does some of the other cutworms. One of the best methods of fighting the greasy cutworm is to turn hogs into the grass fields in the fall of the year several weeks before one wishes to plow the sod under previous to preparing the ground for corn.

THE CLAY-BACKED CUTWORM.

Feltia gladiaria, Norr.

The larvae of the clay-backed cutworm is about one and one-fourth inches in length when full grown and is of a dark brown or greenish-gray color, with a light colored streak along the back. Figure 39 represents one of these larvae enlarged. They occur in variable numbers, depending upon the season, sometimes becoming quite scarce and then again appearing in overwhelming numbers and causing serious and widespread trouble. This variation in numbers depends very largely upon a bacterial disease, which seems to attack them and kill them off very rapidly, especially when the larvae become unduly abundant. They are also, like most cutworms, subject to the attacks of parasitic insects and of birds.

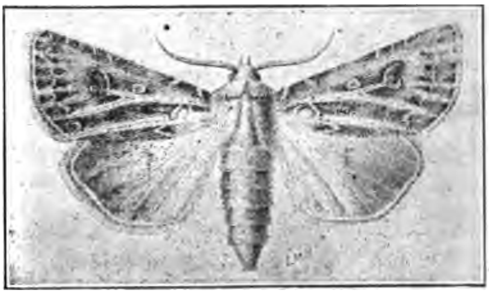


Fig. 38.—The Clay-Backed Cutworm, *Feltia gladiaria*, Adult Moth; enlarged.

These clay-backed cutworms prefer clover in preference to bluegrass, and attack the corn fields more especially when the corn follows the clover field previously turned under; or where the insects are infesting neighboring clover fields in undue numbers, they frequently leave these fields in great abundance, sometimes in a body similar to the army-worm, and are then likely to spread to the corn field and devour it, like unto the well-known army-worm attack, eating the leaves of the corn plant instead of cutting the plant down, as is the case with most cutworms. Their work in the corn fields always consists of eating the leaves and the stems above ground. The larvae are most abundant from the middle of April through May. After May they enter the earth, so that by the middle of June practically all of them have disappeared. They remain in the ground in a dormant condition for upwards of six weeks before they transform to the pupae stage, the moths appearing during September, and soon depositing their eggs. Figure 38 represents a moth enlarged.

The best method of protecting a corn field from the attack of these worms is to plow a furrow along the side nearest the clover field, with vertical side toward the corn, and then dig post holes every five or six feet in this furrow. When the larvae leave the clover field for the corn, not being able to cross the vertical furrow, they will crawl along and fall into the post holes. One can also kill great numbers by scattering poisoned clover or bran about the parts of the corn field where the larvae are entering. Fresh clover dipped into a strong mixture of Paris green and water is as good a method as one can employ. Where one wishes to plant corn in a clover field the following year, he can prevent these adults from laying their eggs nearby by plowing the clover field under by the middle of September.

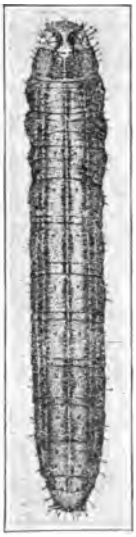


Fig. 39.—The Clay-Backed Cutworm, *Feltia gladiaria* Larva; enlarged.

THE GLASSY CUTWORM.

Hadena devastatrix, Brace.

This glassy cutworm is another very common and widespread one found injuring grass and corn to a great extent in certain localities, frequently becoming the most abundant and destructive cutworm at certain times. The insect derives its name from the fact that the larva is somewhat uniform in color, being light and translucent, with a slightly bluish-green tint, and can be distinguished from some other closely allied cutworms by the fact that the head and shield is of a reddish-brown color. This larva is represented enlarged in figure 41. These larvae sometimes occur in such quantities in grass fields; especially in low parts of the field, as to attract attention by the damage which they do to the grass, causing it to wither and die when the area not so infested is perfectly green. They do not seem to feed upon clover, but feed upon all kinds of grass, including the corn, small grains and most garden vegetables. They are inclined to work under the surface of the soil more than most cutworms, rarely coming to the surface to feed. Because of this fact, they cannot be so readily poisoned as most cutworms are by the use of poisoned bran, nor trapped by the use of boards. They usually cut off the corn plant just below the surface of the ground, or cut off the roots of the corn plant a little deeper, moving through the soil from one plant to another and doing the work principally at night.

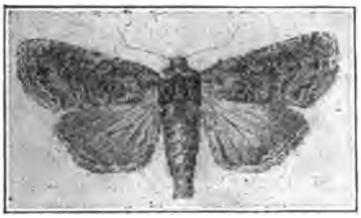


Fig. 40.—The Glossy Cutworm, *Hadena devastatrix*, Adult Moth; natural size.

The adult moth, which is shown in figure 40, appears the last of July and during August, and deposits her eggs in the grass fields principally during the months of August and the forepart of September. The young larvae hatching from these eggs feed upon the roots of grass until the approach of cold weather and then hibernate, the same as our other cutworms. In the spring, especially during May and June, these larvae move about through the soil, feeding upon the roots and cutting down and eating through the stem of corn and other crops. They transform to pupae in the soil, usually a couple of inches below the surface, during the month of July especially.

From what I have briefly given of the life history of the glassy cutworm, one can see that the ordinary methods advisable for most other cutworms will not apply to any great extent here. The fact that these cutworms work usually below the surface of the soil, not coming to the surface as do most cutworms, will prevent the successful application of the poisoned bran method; and the fact that these cutworms lay their eggs almost exclusively in grass fields, and that the eggs are deposited during August and the forepart of September, necessitates the plowing of the grass field during August preceding the year in which we wish to sow it to corn. It is also possible to sow corn late in June and escape the attack of these insects, because of the fact that the bulk of them make their pupae during the first half of July.

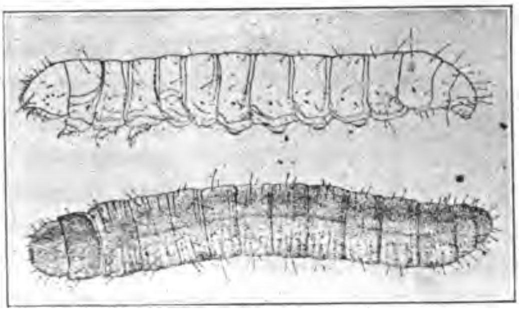


Fig. 41.—The Glossy Cutworm, *Hadena devastatrix*, Larvae; enlarged.

THE BRONZE CUTWORM.

Nephelodes minians, Guen.

The bronze cutworm is one of our largest cutworms, measuring, when full grown, about one and three-fourths inches in length. The larvae are alternately striped with olive bronze and yellow, and the head and shield are yellowish-gray. Figure 43 represents two of these larvae enlarged. They can be easily distinguished from the other cutworms by referring to the figure and the description.

These bronze cutworms seem to prefer timothy grass, and do not eat clover. They frequently occur in such numbers as to completely destroy the timothy fields, in which case they also have the habit of migrating, sometimes in a mass similar to army-worms, and scattering over the neighborhood in search of food. They will also migrate to the corn, in which case they will devour the entire corn plant in a way similar to the work of the army-worm, instead of cutting down plants, as most of our cutworms do. These larvae are most active and abundant in April and May, and by the fifteenth of June all of them have entered the ground, where they remain in a dormant condition until the last of July or during August, when they transform to the pupae stage, the adults appearing in August and September and even into October. Figure 42 represents an adult natural size. They then immediately lay eggs in the timothy field for

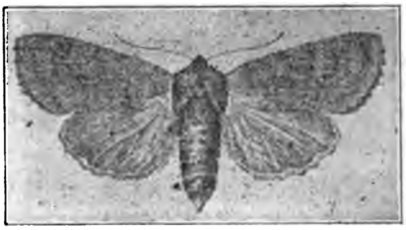


Fig. 42.—The Bronze Cutworm, *Nephelodes minians*, Adult Moth; natural size.

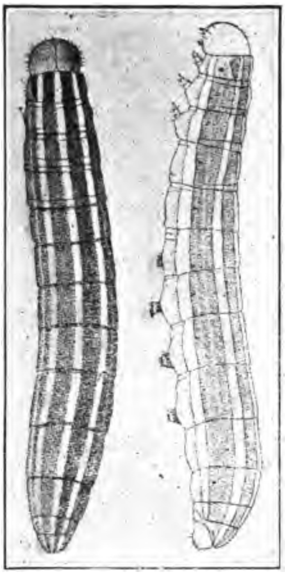


Fig. 43.—The Bronze Cutworm, *Nephelodes minians*, Larvae; enlarged, back and side views.

another brood. The larvae, like the larvae of most of our cutworms, hibernate over winter in the ground about the roots of the plants.

Like the preceding cutworm, these cutworms can also be prevented to a large extent from entering the corn field by the furrow method, or by poisoning them with bran mixed with Paris green and sweetened water. Where it becomes necessary to replant a corn field that has been injured by these cutworms, it can be safely done after the first of June. One can also largely prevent the development of these cutworms by plowing under the timothy fields intended for corn by the first of September, thus doing away with the places for the insects to deposit their eggs.

THE CORN BILL-BUGS.

Sphenophrous parvulus; S. ochreus; S. pertinax.

The corn bill-bugs are beetles belonging to the family Curculionidae, which consists of our so-called "snout-beetles." While we have several species of corn bill-bugs, three of them are more commonly found injuring corn. One, *S. parvulus,* is a small species that infests timothy and grass plants, and the other two, *S. ochreus* and *S. pertinax,* are much larger insects, and are found infesting large swamp grasses and sedges, such as rushes, reeds, etc. One species, *S. ochreus,* sometimes becomes nearly three-fourths of an inch in length, but they vary wonderfully in size, some of them being scarcely one-half inch in length. These three species of bill-bugs are reresented enlarged in figures 44, 45 and 46. The figure at the bottom in each case will give one a very good idea of the shape and comparative size of the snout or beak, which is so characteristic of the mem-

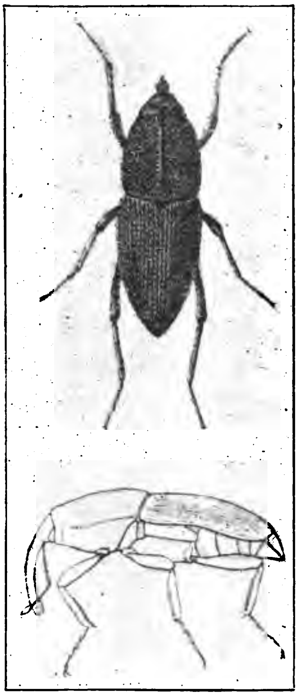


Fig. 44.—The Corn Bill-Bug, *Sphenophorus parvulus,* Adult beetles; greatly enlarged.

bers of this family. The mouth parts are situated on the extreme end of this snout, and it is by means of these that the insects do their damage to the corn.

These insects vary in color from a light brown to a dark brown, and the body is more or less covered with small narrow grooves and dot-like depressions. These insects pass the winter as hibernating adult beetles, and are found under rubbish of all kinds in the grass field and also in the swamp land that is grown up with the various large grasses, reeds, rushes, etc. In the spring of the year, as soon as warm weather appears, these insects come forth, and in May and June deposit their eggs at the bases of these plants. The larvae feed upon the fibrous roots, but more especially upon the bulbous roots of various grasses and sedges, mining inside and hollowing them out, rarely eating up into the base of the stem to any considerable extent. These footless, grub-like larvae, one of which is represented greatly enlarged in figure 47, may be found by pulling up the various grasses and sedges and examining the bulbous roots, inside of which they may be found at any time during June, July and August. The larvae form pupae inside the hollowed out bulbous roots, and transform to beetles late in the summer or in the early fall; these beetles remain in the field in which they hatch and hibernate over winter there, not depositing their eggs for another brood until the following spring.

When grass lands or swamp lands are plowed in the spring of the year and planted to corn, these various bill-bugs in the adult condition attack the young corn plant near the base, and by eating holes through the leaves and stem, enter into and hollow out the inside, and thus feed upon the soft tissues, frequently splitting the stalk and hollowing it out along the split portion. As the plant grows and the leaves which are at first folded about the stem unfold and protrude, one notices series of parallel, circular or oblong holes through the leaves. While there may be three or four such series parallel to one another across the leaf, yet they were made by a single puncture at the time the leaves were folded about the stem. The chances are that

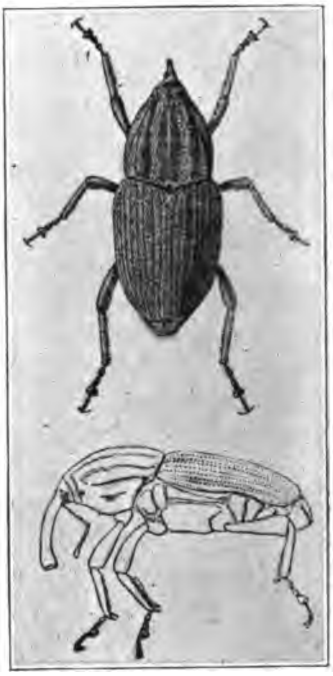


Fig. 45.—The Corn Bill-Bug, *Sphenophorus ochreus*, Adult Beetles; enlarged.

the first indication one will have of the presence of these bill-bugs in the corn field will be the peculiarly shaped and located holes through the leaves. The bill-bugs may eat several holes through the leaves and stem, as above described, and in that case may kill the plant outright. These bill-bugs may be observed at work in the corn field with their heads downward, where they will not be easily disturbed.

The injury which these beetles do by thus eating through and hollowing out the young corn stalk varies from complete destruction of the corn, even of the second and third plantings, to scarcely a noticeable damage, depending a great deal upon the amount of injury, the fertility of the soil and the rain conditions, as well as the number of beetles which are thus attacking the corn. The most common damage these insects do to the corn is to weaken it, so that it does not produce ears at all or produces simply nubbins; and also in so weakening the corn plant that it does not form proper brace roots and is therefore easily blown over, and when once down, does not right itself.

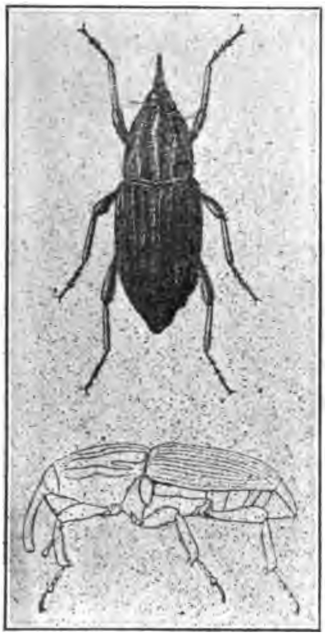


Fig. 46.—The Corn Bill-Bug, *Sphenophorus pertinax*, Adult Beetles; enlarged.

In a great majority of complaints we have received from these insects, the injury has come to corn in low lands that have been recently drained, and the large swamp grasses, sedges, etc., that have been growing for years in great abundance and have harbored these insects, has recently been plowed under and put in corn. Occasionally, however, complaints have come in where injury has been caused by one of these bill-bugs, viz., *S. parvulus*, on high, well drained timothy and bluegrass pastures. This insect, viz., *S. parvulus*, is a small bill-bug, and is able to live in the larval condition in the bulbous roots of timothy and even blugrass. The other species, however, are much larger and live in the bulbous roots of the larger swamp grasses, sedges, rushes, reeds, etc. It is not an uncommon thing to have reports from corn in low lands to the effect that fifty per cent of the corn is a total loss, judging from what the field would produce under normal conditions without the presence of these insects.

The only satisfactory method of preventing injury by these corn bill-bugs, which, as I say, is confined to corn entirely, and only by the work of the adult beetles in the early summer while the corn is young, is to take advantage of the life history of this insect, as above given, which shows that the insects do not breed at all in the corn field. No larvae have ever been found infesting corn, so far as I am aware, the larvae breeding only in the grass, sedges, etc. The adults, so far as known, will not lay their eggs in the corn field, but will, when disturbed in their natural localities, as will be the case if the field be plowed before the eggs are deposited, seek other fields. Therefore, by plowing the intended field early in the fall, before the beetles have gone into hibernating quarters, one will thus turn under the grass, sedges, etc., and in the spring of the year, when the beetles come out to deposit their eggs, there being no suitable natural food plants in this field, they will fly to other fields, and the corn that is put in this plowed field will escape the attack of these beetles. The great bulk of these beetles will leave the plowed field and seek the unplowed ones in order to hibernate, and what few may remain in the plowed field will, in the spring of the year, fly to unplowed fields in order to deposit their eggs. The mistake which is usually made is to plow the field in the spring of the year. Such fields are sure to be attacked by these beetles. The early fall plowing is the only successful method of preventing their attack. It is not necessary to plant other crops than corn in a badly infested swamp field, since by the method of procedure above described the insects can be kept out; and crops such as hemp, etc., need not follow the newly turned under grass in swamp lands.

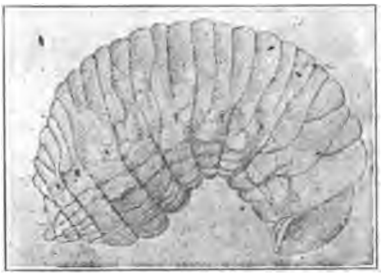


Fig. 47.—The Corn Bill-Bug, *Sphenophorus ochreus*, Larva; greatly enlarged.

THE STALK-BORER.

Papaipema (Hydroecia) nitela, Guen.

This stalk-borer frequently does damage to corn in various places in this State, especially along the edges of the corn field bordering grass. It is a very rare thing indeed that this insect spreads out over the entire field; so that the damage they do is not as serious as that of the other insects we have described. Like many of our other corn insects, these also are normally grass-feeding insects and get into corn when adjacent to their normal food plant. Very frequently one finds the grass, especially timothy, with certain stems and heads dying and turning white, while the rest of the plant and other plants about it are perfectly green. This is a very sure sign of the presence of this stalk-borer, or at least of some of its near relatives. When the grass near a corn field becomes thus injured, one can expect the first few rows of corn adjoining this infested grass field to become injured by these insects.

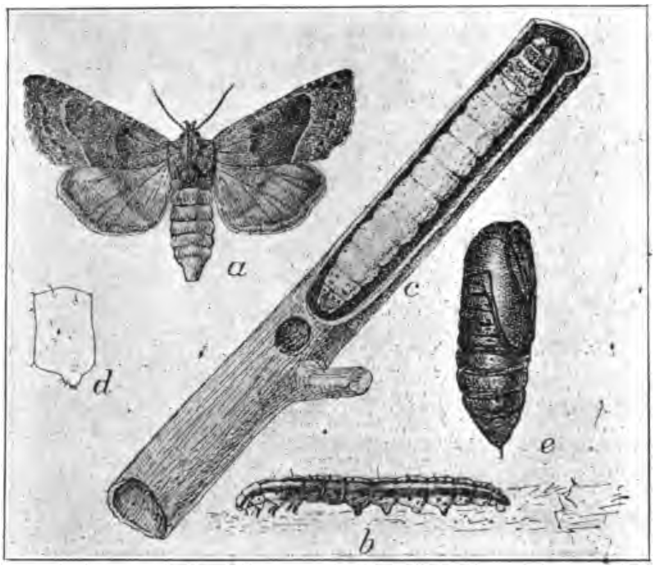


Fig. 48.—The Stalk-Borer, *Papaipema* (*Hydroccia*) *nitela*; *a*, Adult Moth; *b*, half grown larva; *c*, mature larva in burrow; *e*, pupa. All slightly enlarged. (From Chittenden, U. S. Dept. Agriculture.)

The larvae of the stalk-borer, when full grown, is about one inch in length, and varies in color from a very light brown to a purplish brown, according to the age, the older ones being lighter. The body is striped with five white bands, the two lateral ones being interrupted or wanting on the first four abdominal segments. The head and anal shield are reddish-yellow. The stripes, which are so prominent on the larvae before they are full grown, become somewhat obscure as the insects reach the full grown larval stage. A good idea of the general appearance of these larvae when not full grown can be had by referring to figure 48, *b*, and a full grown larvae in figure 48, *c*.

When these larvae hatch from the eggs, which are deposited in the grass fields or grassy places about the roads, fences and byways, they eat a hole through the stem of the grass plant and make a burrow up the center of the grass stem. The opening through which they enter soon becomes stopped up with their droppings. The plant above the point of entrance withers, dies and turns white, and can be readily distinguished from the other parts of the plant or from other uninfested plants. After a time these larvae become too large for the small stem of the timothy, and much more so for the bluegrass, and they then eat their way out of the grass stem and crawl about in search of some other plant that will afford them a larger stem in which to mine.

It is at this time that the larvae will enter the corn field, the corn being from two inches to ten inches in height, and the larvae then crawl up the stem a short distance and make a hole through it, and mine upwards in the middle of the stalk. This, of course, causes the same damage to the corn as the burrowing of the larva in the stalk of grass did, viz., to cause the corn above the point of entrance to wither and dry up, turn white and die, and perhaps fall over, breaking off at the point where the larva entered. One of these larvae is shown inside of a stalk with the opening through which it entered in figure 48, *c*.

The larvae may leave the corn plant by eating a hole through the stem above the one through which it entered, and pass to another corn plant, burrowing in it the same as before described. These larvae, when full grown, are very apt to mine down below the original point of entrance and there transform to the pupae stage. If, therefore, the upper and dead or injured portion of the stalk breaks off and falls to the ground, the pupae are still left in the healthy, or at least standing, stalk. A pupae is represented in figure 48, *e*.

The larvae become full grown about the last of July, and the adults appear from the middle of August through September and into October. These adults are handsome moths of a mouse or fawn gray color, with the outer third of the wings lighter, and a light or almost white band separating the two regions. One of these moths is shown in figure 48, *a*.

So far as is known, these moths do not lay their eggs in anything but grass. There is but one brood of these insects a year, the winter being passed in the egg stage, hence there is no danger of a corn field becoming widely infested with these insects, and this accounts for the fact that the insect rarely is found distributed over an entire field of considerable size. This stalk-borer, while feeding normally upon timothy and bluegrass for its early larval existence, is forced, as it becomes too large for the stalks of these plants, to seek other plants with larger stems, and in doing so, the larvae will infest wheat and oat fields, as well as corn, and will also burrow in potatoes, rhubarb, tomatoes, spinach, blackberry and raspberry canes near the tip, cockle-bur, rag-weed, burdock, almost all kinds of garden flowers, and also in the new growth of currant, peach, apple, grape, and willow stems. In fact, these insects seem to have no especial preference for any one plant, or even any particular group of plants, so long as they are large enough and tender enough to allow them to burrow inside their stems.

From what has been said, one can readily see that it is not necessary to unduly worry about these insects when they are found infesting the first few rows of corn. Uusually by the time the insects are discovered the bulk of the work has been accomplished, and no economic remedy is at hand for the destruction or prevention of this trouble. About the only thing that one can do is to guard against the probability of these insects getting into the first few rows of corn adjacent to the grass land by mowing the grass and feeding it out to stock immediately before the larvae have a chance to come out and migrate to other plants. This can be easily determined because one will notice certain stems of the grass plants dying and turning white, while the others are perfectly green, and the rest of the plant below the point of entrance of the larva is still green. Outside of these simple methods of getting rid of the larvae that one finds infesting the neighboring grass fields, there is nothing the farmer can do to rid himself or prevent or check the injury from these insects.

THE CHINCH BUG.

Blissus leucopterus, Say.

INTRODUCTION.

The chinch bug is perhaps the most widely destructive insect affecting the corn plant. It is broad in its selection of food, and infests nearly all the members of the grass family. This includes, of course, the wheat and other grains, and the corn et al. While it will feed when forced to, on account of the scarcity of other varieties, upon practically all members of the grass family, yet it has its preferences, and seems to prefer, other things being equal, such cultivated grasses as Hungarian grass, Panicum crus-galli, millet, Setaria glauca, bluegrass, wheat, corn sorghum, broom corn, Bermuda grass and crab grass. It will thus be seen that the insect will live and multiply upon various grasses in regions where there is very little or no wheat or corn. In the State of Missouri the insect does its vast amount of damage by attacking the wheat and corn plants.

DISTRIBUTION.

The distribution of the chinch bug in North America is confined very largely to that portion east of the Rocky Mountain region, extending from the Great Lakes to the Gulf of Mexico. The insect is found west of the Rocky Mountains in only isolated places. By observing the

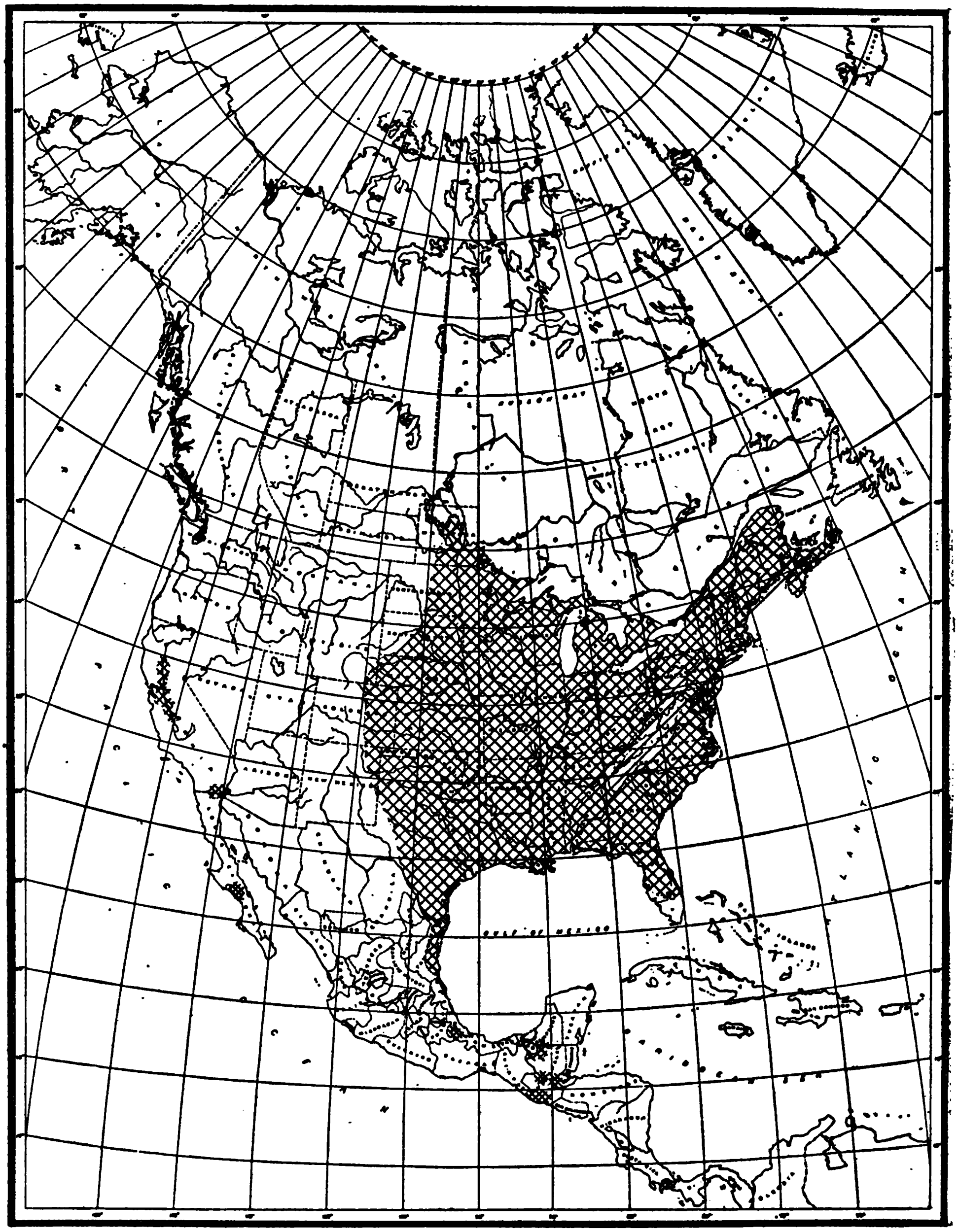


Fig. 49.—Map of North America showing areas infested by Chinch Bug. (From Webster, U. S. Dept. Agric.)

map of North America, shown in figure 49, one can see at a glance the known areas of the chinch bug infestation. It should not be understood, however, that the chinch bug does an unusual amount of damage throughout this entire area. As a matter of fact, its region of greatest destructiveness is confined to the following states: Ohio, Indiana, Illinois, Minnesota, Iowa, Missouri, Nebraska, Kansas, Oklahoma, Indian Territory, Virginia, North Carolina and South Carolina. Of these twelve states, Ohio, Indiana, Illinois, Iowa, Missouri, Kansas, Nebraska, Minnesota and the Indian Territory are by far the greatest sufferers. A glance at the map of the United States, shown in Figure 50, will give you an excellent idea of the area of greatest destructiveness. In the states just mentioned we expect a great annual loss from the ravages of the chinch bug; but like many other injurious insects, the chinch bugs have their ups and downs, and will, as a rule, increase in number and destructiveness for two or three years before they reach their highest ambitions in this direction, and then they will drop down to comparatively normal numbers again, and then gradually increase until the height is again attained. They behave very much like spasmodic waves passing over the country.

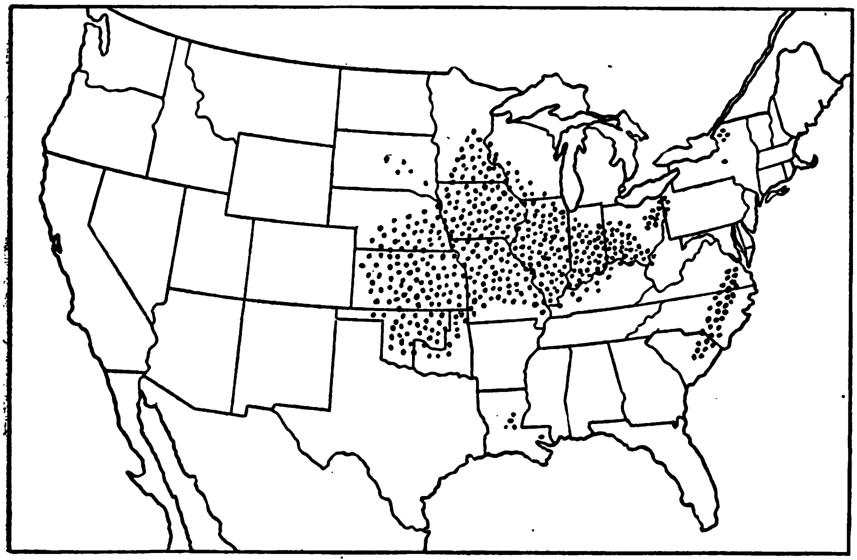


Fig. 50.—Map showing areas in the United States over which the Chinch Bug occurs in most destructive numbers. (From Webster, U. S. Dept. Agric.)

While the chinch bug has been with us for a great many years, in all too numerous quantities every year, yet in some years, as for instance 1871, the chinch bugs have been unusually numerous and destructive.

It was carefully computed by Dr. LeBaron, then State Entomologist of Illinois, that the loss in the single year 1871, in only seven states, by the ravages of the chinch bug was $30,000,000. Those seven states were Iowa, Illinois, Kansas, Nebraska, Wisconsin and Indiana. In the year 1874 the chinch bug was again unusually destructive, and in Missouri alone, Dr. C. V. Riley, then State Entomologist of Missouri, computed the loss in this one State by the ravages of this one insect during that single year at $19,000,000, and stated that for the seven states I have above mentioned the loss for that one year might safely be estimated at $60,000,000. The loss in the United States for that one year has been estimated at upwards of $100,000,000. While these estimates are undoubtedly correct, they are enormous, and cover the ravages of but this single insect during one single season. If we take into account the aggregate losses from year to year, one could hardly realize that insects could cause so much damages.

THE DIFFERENT STAGES OF THE CHINCH BUG.

The chinch bug is so well known to most farmers of Missouri that it hardly seems necessary to give any detailed description of it, although the false chinch bug is very often mistaken for it. A short description of the different stages of the insect, however, may not be out of place, since the insects differ in their coloring to such an extent between the young and adult stages.

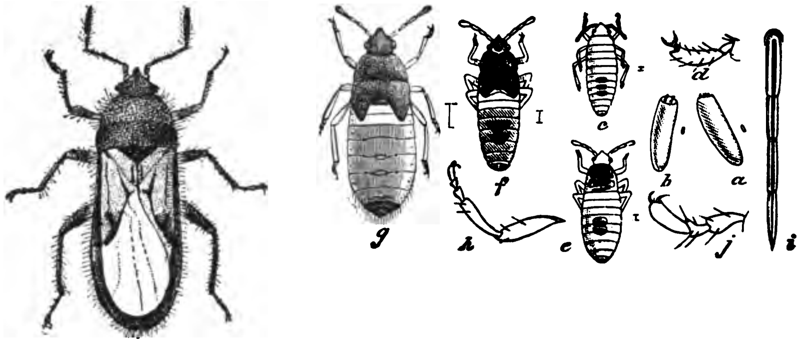


Fig. 51.—Chinch Bug, *Blissus leucopterus*, showing different stages in its development: *a, b*, eggs; *c*, newly hatched bug; *d*, its tarsus; *e*, bug after first molt; *f*, same after second molt; *g*, same after third molt; at the left an adult which is the result of the fourth molt, much more magnified; *h*, enlarged leg of adult bug; *i*, proboscis or beak enlarged; *j*, tarsus of same still more enlarged. The lines at the sides of each bug represent its natural size. (From Webster and Riley, U. S. Dept. Agric.)

The *eggs* of the chinch bug are very small and are deposited in masses, each female depositing upwards of five hundred eggs. The eggs, however, are not all deposited in one mass, but may be scattered in several masses; and are placed, as a rule, just under the surface of the ground near or upon the roots or the base of the stems of the grass or the corn plant, as the case may be. The eggs, while large for an insect the size of the chinch bug, are really very small, measuring only three-hundredths of an inch in length. See figure 51, *a, b,* which represents two eggs greatly enlarged. When in masses, such eggs appear of a whitish, translucent color when first deposited, but later become amber colored, and just before they are ready to hatch have a decided reddish hue, due to the fact that the young insect shows through the egg envelope.

While most farmers have not observed the eggs of the chinch bug, it is really a very simple matter. If they will pull up clumps or bunches of grass and carefully pull the dirt away from the roots, they will find the little masses of eggs tucked away just under the little clumps of dirt about the base of the plant. Occasionally the eggs are deposited on the stem or between the stem and leaf, above the ground, or between the earth and stem of the plant, rarely on the leaves or further up the plant. See figure 52, *g,* which represents the masses of eggs about the roots of a wheat plant, and also some masses on the lower leaf. The females take from two to four weeks to deposit their eggs. The eggs hatch in about two weeks, but vary considerably according to the weather. In some instances they may hatch in ten days, and in other cases they may take three weeks. From the time the egg hatches until the adult stage is reached requires about forty days. Hence you can readily see that from the time the first eggs are deposited until the first adults of this brood appear would require practically two months.

The *young* chinch bugs when they first hatch look very little like the adult. They are very small, of a pale yellow color, and with an orange spot on the back of three abdominal segments. See figure 51, *c,* and figure 52, *b.* In form these newly hatched bugs are not unlike the adult, but of course, they have no wings whatever. As soon as hatched, they lose no time in seeking a place in which to insert their beaks through the tissues of the plant and suck the sap. After a time they have grown in size so that their skin becomes too small for them; it then splits open along the back and the creature crawls out, leaving its first skin behind. This is known as the first molt. The insect now appears quite decidedly red, or vermillion, with a pale band across the middle of the body. See figure 51, *e,* and figure 52, *c.* After feeding for some time the larva again becomes too large for its old coat, and it again splits open along the back and the creature crawls out, leaving its cast skin behind a second time. The insect now has a dusky head and thorax, while the abdomen is of a duller red, with the pale band still distinct. See figure 51, *f,* and figure 52, *d.* The future wing pads now become apparent.

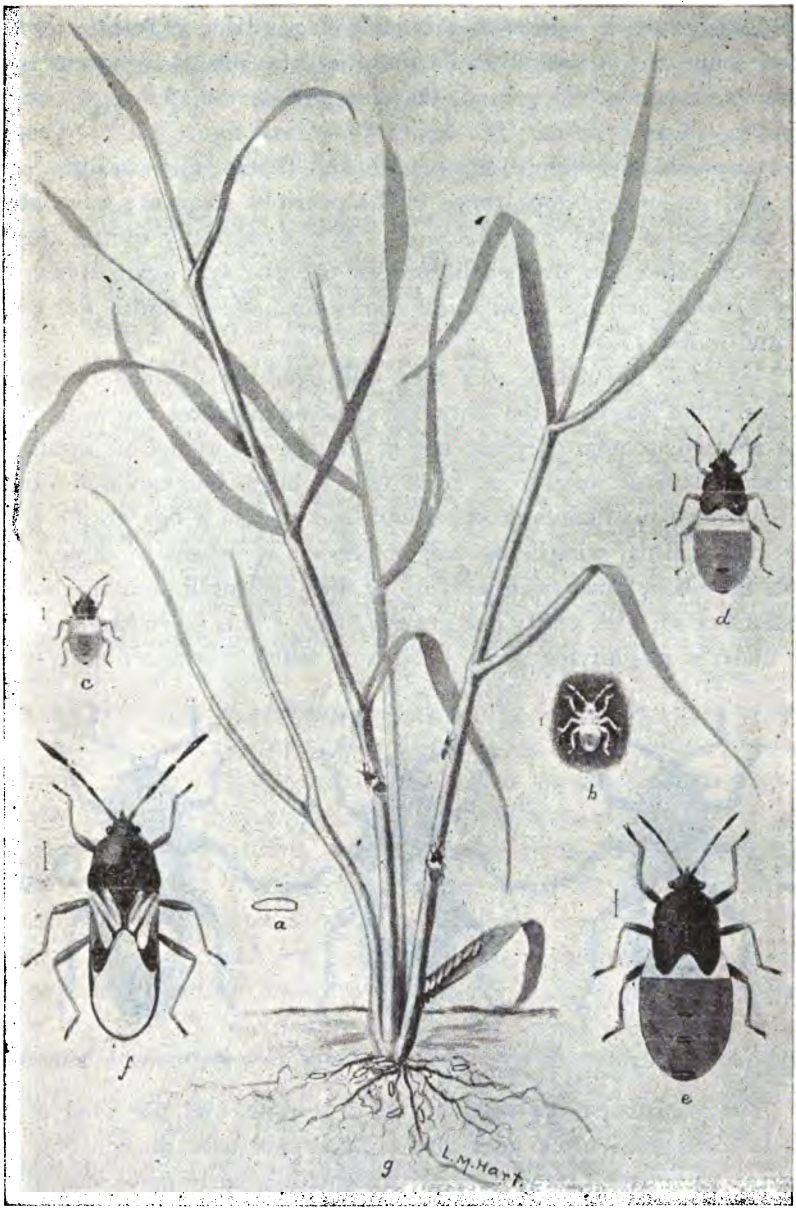


Fig. 52.—Chinch Bug, *Blissus leucopterus*, and wheat plant. On the stems are three bugs natural size; *a*, an egg greatly enlarged; *g*, egg masses on roots and on lower leaf; *b*, *c*, *d*, *e*, young chinch bugs after succeeding molts; *f*, adult chinch bug. A molt occurs between each stage. The hair lines indicate the natural size of each stage. (After Lugger.)

After feeding and growing for a time this young chinch bug again sheds its skin. This is the third molt; and this stage of the young bug, which is its fourth stage since leaving the egg, is sometimes spoken of as the pupa stage, since it is next to the adult stage. But in reality there is no true pupa in this case, because these insects develop by means of an incomplete metamorphosis, and, therefore, these younger stages should all be known as nymphs. See figure 51, *g*, and figure 52, *e*. This so-called pupa has a brownish-black head and thorax, and the little wing pads that made their appearance in the previous stage are now larger. The abdomen is dingy gray in color, with a dark horny spot at the tip. When this insect has reached its proper size, the skin again splits open along its back, and the adult insect comes forth. See figure 51, cut at left, and figure 52, *f*.

This *adult* insect has, as a rule, well developed wings extending practically the length of the body, but in some instances the wings seem to be aborted, so that they are not fit for use as organs of flight. By observing a great number of adult chinch bugs, one can find various stages, from the adults with very short and useless wings, to the adults with long, normal wings, that are of service as organs of flight. The adults are about three-twentieths of an inch in length, and the body is of a black color, with a very fine grayish down. This down can be readily seen under a magnifying glass, but is not visible to the ordinary naked eye. The wings and the wing covers are white, and the wing covers have two irregular black lines and a black spot near the margin. By referring to figures 51 and 52, one can obtain a fairly good idea of the general shape and comparative size of the different stages of chinch bug, from the time they hatch, up through the various stages that I have just described to the adult bug. While the figures show simply the comparative or relative size and the general markings, they do not show the

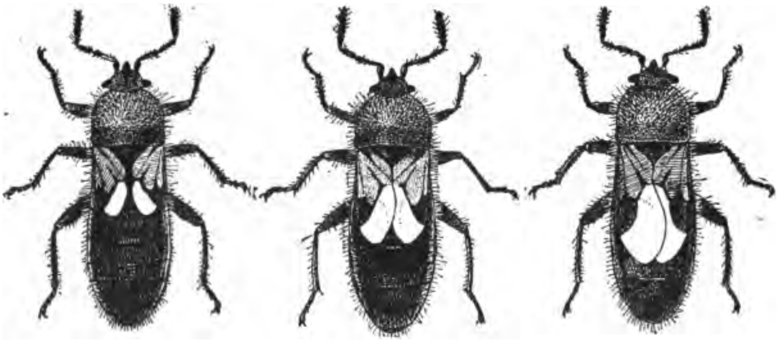


Fig. 53.—Chinch Bug, *Blissus leucopterus*. Adults of short-winged form—much enlarged. (From Webster, U. S. Dept. Agric.)

color, which differs so greatly between the adult and the younger stages. Figure 51, bug to the left, shows an adult with normal wings, while figure 53, shows three adults with the aborted wings of different lengths, the one to the left showing very small aborted wings, and the one to the right showing an adult with wings nearly of normal size. Of course, all of these figures show the insects greatly enlarged.

HOW AND WHERE THE CHINCH BUGS SPEND THE WINTER.

Chinch bugs always hibernate in the adult condition during the winter. While there are possibly no exceptions to this rule, at least in Missouri, yet it is a fact that by the time the chinch bugs are forced to seek winter quarters, some of them are not quite full grown or adult insects. It appears that those chinch bugs that seek winter quarters before they reach the adult condition fail for some reason to live through the winter. While this may not lessen the number of chinch bugs to any appreciable extent, it nevertheless is a fortunate circumstance. Late in the fall, when the proper food plants have become more or less dried and cooler weather is approaching, the chinch bugs begin to migrate and scatter, leaving the plants or the fields in which they have been feeding, and crawl about or fly, as the case may be, in search of suitable places in which to pass the winter. This migration usually occurs in Missouri at the time most people call "Indian Summer." The great bulk of chinch bugs have by this time reached the adult condition and have fully developed wings, by means of which they can fly from place to place and scatter about the neighborhood. But it is a very common sight to see those chinch bugs that are able to fly crawling about, occasionally in large numbers, even in the villages, showing that they have come from the neighboring country, probably by flight. Very frequently they occur in villages at this time of year in such immense numbers as to attract a great deal of attention from the village people, who do not understand the invasion or the name of the insect. Chinch bugs are very apt to leave in great numbers the fields that they have infested during the summer, especially if these fields do not contain a sufficient amount of grass and weeds or shocks of corn, and seek such places as the edge of timber, Osage orange hedges, wind breaks, places where there is plenty of rubbish as along fences, among stone piles or wood piles, hay and straw stacks, and places where there are great masses of rank growth of grass and weeds, especially in corners of rail fences. The insects crawl under such rubbish, especially under leaves and under matted grass, and will collect in these places in vast numbers. They seek especially the above places that are on high, well drained ground, and seem to prefer sandy or rocky soil to mucky.

They shun to a great extent the low places that are liable to become flooded or become excessively damp.

During the winter these insects remain in a dormant condition in these sheltered, protected and more or less dry places, and may be readily found during the winter in great numbers by the ordinary farmer, if he will take the trouble to turn over the rubbish near the ground in the places I have mentioned. These insects, however, will become more or less active and sometimes crawl about during warm days that occur at frequent intervals during our winters here in Missouri. No amount of cold seems to affect the insects whatever; at least 30 degrees below zero has no terror for them, that temperature having been reached in Missouri. In some of the northern states they have been known to withstand 40 degrees below zero without any apparent inconvenience. They seem to stand continuous cold weather better than they can the rapid changes in temperature, from extreme cold to comparative warm, spring-like weather and then suddenly turning cold again, as usually happens during our Missouri winters. Those immature chinch bugs that go into winter quarters probably perish from the alternate cold and warm weather as well as from dampness. It appears that the immature insects especially cannot endure any great amount of moisture. They seem to have an instinct that teaches them to seek dry places, and the shocks of corn that are so common in this State afford the very best places for these insects to collect in the fall and hibernate during the winter. It is no uncommon thing to see thousands of these chinch-bugs under a single shock.

THE LIFE HISTORY OF THE CHINCH BUG.

In the spring, as soon as settled warm weather appears and the grass begins to grow, the adult chinch bugs that have passed the winter come forth from their hiding places and fly about in search of suitable food. In some springs the insects at this time are so numerous that they attract a great deal of attention from people in the towns by alighting upon them, sometimes by the dozens, especially is this the case if they chance to drive out into the country a little ways. It appears that, in Missouri at least, this is the great migrating season, a season in which the chinch bugs seems to scatter over vast areas and cover greater distances than is the case with the fall migration just previous to their seeking winter quarters. Of course, a great many of these chinch bugs do a great deal of crawling instead of flying, but it has been my observation that the vast majority of chinch bugs coming out in the spring from their winter quarters fly instead of crawl; while the migration in the fall is, to a very large extent, confined to crawling instead of flying. After the insects have found suitable fields or suitable plants for their food, they alight and crawl about, inserting their beaks through the tissues of the plant and suck its sap. Chinch bugs in seeking their proper food plants in the spring alight in immense numbers in our wheat fields. If the wheat fields happen to be near a wood, or Osage orange hedge fence, or a wind break, or a place where there is plenty of shelter, in which vast numbers have hibernated during the winter, then, in this case, the chinch bugs are very apt to come out from their winter quarters and crawl in vast numbers to the wheat field. In such instances they are usually found collected or massed together on the plants nearest the hibernating quarters, and their presence will soon be detected by the effect that they have upon the plants. It seems that chinch bugs, when they insert their little beaks into the plants, involuntarily inject a little poison, which poison causes an increased flow of sap to that place, and has more to do with the injury to the plant than the amount of sap which the insect actually extracts. A wheat field attacked in the way just mentioned will appear bleached in the area or strip attacked. If left undisturbed, the chinch bugs will gradually spread from plant to plant, so that the area of infestation will increase and move onward, gradually covering the entire field.

While a great many chinch bugs mate in the fall, the vast majority of them mate in the spring soon after leaving their winter quarters, and presently the females begin to deposit their eggs in the wheat fields and grassy places, usually just below the surface of the ground under little clods of earth about the roots and base of the plants. In about sixteen days these eggs will begin to hatch, and presently the agriculturist will detect the little yellow or reddish bugs in his wheat. In about six weeks these insects will have reached the adult condition, and his wheat field wil be literally over-run with chinch bugs. Meantime, the young bugs have been drawing their nourishment from the wheat plants by sucking the sap, and have done more or less damage, according to the number of bugs in the field. Since each female lays upwards of five hundred eggs, one can form an idea of the extent of the multiplication of these insects since leaving their winter quarters. As the females take about three weeks to deposit their eggs, and as these insects hatch according to the weather, we find that new adult chinch bugs are appearing for three weeks or more after the first ones have appeared. At about the time the chinch bugs have become dangerously numerous in the wheat field, the great bulk of them have become adults, and have done a great deal of damage and the wheat plant has become ripened and no longer fit for their food. The chinch bugs in such a field now take it into their little heads to seek green pastures, and they usually do so all at once, and migrate in a body, leaving the old field. In this migrating army we find the adults with fully developed wings and perfectly capable of flight, and the young ones in various stages of development. It is a curious fact that in this migrating army of chinch bugs the adults with fully developed wings rarely attempt to fly, but crawl along with the mass the same as those immature bugs that cannot fly. In fact, it seems difficult to induce the chinch bugs to fly at this time, and it is curious to watch such a migrating army when they attempt to cross dusty roads or plowed fields. The adult bugs will struggle along with the immature ones and not attempt to fly, when by so doing they could readily span the difficult places.

At this season the chinch bugs are very sure to migrate in the above described way from the wheat field to the corn field, and when they reach the corn field they are tired and hungry, and undoubtedly thirsty, for they attack the first corn plant and begin to insert their beaks and immediately suck the sap from the plant. At this time the bugs will cover the first few rows of corn to such an extent as to render it black with them, and especially is this the case with the lower part of the corn plant. The bugs will remain here on the first few rows of corn for a short time and then they will gradually disperse throughout the corn field. The adults now pair and lay their eggs for another brood, and this second brood of chinch bugs, in addition to the first brood which has now migrated, infest the corn and cause the vast amount of mischief so well known to the farmers of Missouri.

By the time the bulk of this second brood of chinch bugs in the corn have reached the adult condition, the time has approached for them to seek winter quarters, and the fall migration begins to occur. If the proper winter quarters are near at hand, the bulk of the insects will migrate on foot to those places; otherwise, the winged forms will now readily take to flight and travel considerable distances in search of suitable places in which to pass the winter. If the corn is cut at this time and stacked in shocks about the field, the farmer has given these chinch bugs the best kind of winter quarters, and they will readily seek them and hibernate in vast numbers in these situations. It will be seen then that chinch bugs have three migrating periods. A period in the fall, during which they migrate by crawling and by flight in search of winter quarters; a migrating period in the spring, when the insects come out from their winter's hibernation and fly about in search of proper food plants; and a mid-summer migration, in which the chinch bugs crawl in a mass in search of fresh supply of food and rarely take to flight. There are, in Missouri at least only two broods of the chinch bug each year, but these two broods always occur.

NATURAL ENEMIES.

Unfortunately for the agriculturist, at least, the chinch bug has few natural enemies; especially is this the case with its insect enemies. Most insects are held in check by other insects that are either predaceous (that is, devour them), or are parasitic upon or in them. But the chinch bug seems to be largely immune from the attack of either the predaceous or the parasitic insects; at least, they are not in sufficient quantities to do us any particular good in that direction, and it therefore seems hopeless for the agriculturist to ever expect that the chinch bug will be sufficiently held in check by other insects. One of the predaceous insects most destructive to the chinch bug is shown in figure 54. There are some birds, however, that feed upon chinch bugs, but, unfortunately, the birds are so scarce now-a-days that we can hope for very little help from this source. The quail is perhaps the most beneficial bird that we have along these lines, for they devour great numbers of chinch bugs, but quail are sought as a game bird with such diligence that they are becoming extremely scarce. Meadow larks also devour immense numbers of chinch bugs—perhaps as many as do the quail, but here again these birds are also killed as game birds. Prairie chickens, red-wing black birds, catbirds and thrushes also readily feed upon chinch bugs.

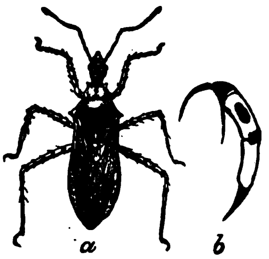


Fig. 54.—A Predaceous Bug, *Milyas cinctus*, which feeds on chinch bugs by sucking their blood. (From Riley, U. S. Dept. Agric.)

There are certain fungoid and bacterial diseases that attack chinch bugs under certain conditions, and these diseases do more good towards keeping the chinch bugs in check than all the other natural enemies of the chinch bug combined. However, we cannot ever hope to see the day in this region of the United States when the natural enemies of the chinch bug will ever keep it reduced in numbers to within harmless bounds. We must assist nature with her task by artificial means. From what has been said in regard to the habits and life history of the insect, it is apparent to anyone giving the subject any particular thought, that the chinch bug has several weak points that we can take advantage of.

REMEDIES.

It is advisable that the agriculturist resort to every means possible within the bounds of reason looking towards the suppression of the chinch bug. There can be no doubt that if all or the great bulk of agriculturists will see to it that proper means are taken each year to hold the chinch bug in check and reduce its numbers, that in a few years the chinch bug will cause no more loss than is caused by a great many other injurious insects. The great difficulty, however, is to educate the mass of agricultural people up to the point of living up to such rules. The farmers are busy during the summer, and, as a rule, do not feel like taking any time to the fighting of insects. They feel like relying more upon some remedy that can be easily applied, with a hope that it will suffice; and in the great bulk of cases, they will not take the pains to do this in as thorough a manner as they should.

In the first place, every agriculturist should take advantage of the fact that chinch bugs hibernate in the adult condition during winter under rubbish of various kinds, as before described. If the farm is kept thoroughly clean, and no rubbish of any description or no hedge fences or other places where the insects can readily hibernate are allowed, then there will be little chance of the chinch bug hibernating on the farm. In other words, clean farming will do a great deal towards lessening the number of chinch bugs. If the rubbish of various kinds is gathered from the fields and from about the corners of fences, and placed in piles or in rows early in the fall, and allowed to remain there until the chinch bugs have collected under these for their winter quarters, and these are then burned, vast numbers of the chinch bugs will be destroyed with them. There are a great many hedge fences in this country that contain dead grass and weeds, and rubbish of various kinds, that could well be set on fire late in the fall, and thereby destroy the hibernating bugs. If dead leaves and the like, especially those along the side of forests and other wind breaks in the neighborhood of cultivated fields that are infested, are burned over late in the fall, great numbers of hibernating bugs will be killed.

Then, again, if the farmers will sow millet at the proper time, so that the millet will be up early in the spring, it will attract the migrating chinch bugs that are coming out from their winter quarters, and they will collect upon the millet in great numbers, and can readily be destroyed by spraying with kerosene, or by scattering straw over the millet and setting fire to it. This millet trap can profitably be used along the border of those places where the chinch bugs hibernate, or along the line separating an agriculturist's farm from his neighbors.

The practice, which is so common in Missouri, of stacking the corn in shocks in the field, and then cultivating and sowing wheat there, is a very bad one for the chinch bug proposition, because the chinch bugs in such a corn field hibernate under these shocks in vast numbers, probably the bulk of the chinch bugs in such a field seeking this place of hibernation, and in the spring they have but a few feet to crawl before they are upon the young wheat plant, and in that way the farmer simply reinfests his fields in as thorough a manner as could be done. Once the chinch bugs are in a wheat field, practically no artificial means can be taken, from an economic standpoint at least, looking towards any help from this evil.

We cannot economically kill chinch bugs that are scattered over a wheat or corn field; but it sometimes happens that the chinch bugs in the spring coming from their winter quarters, especially if the wheat field be near a forest, will get upon the first few feet bordering such forests, and collect in great numbers, forming a band but a few feet wide along this area. In such cases, it would pay to spray that badly infested area with kerosene emulsion or ten per cent kerosene, as will be described later on.

A great many people send to this office in the spring of the year for the chinch bug disease, with the idea of scattering this disease about the fields of wheat and killing the chinch bugs infecting them. It is a fact that under certain climatic conditions this chinch bug disease, which, by the way, is nothing more or less than a minute fungous plant, will kill great numbers of chinch bugs. But, from seven years' experience and observation of this disease in the wheat and corn fields throughout the State of Missouri, I am firmly convinced that the artificial use of this disease by the farmers of Missouri does very little, if any, good. This tallies with the experience of other Entomologists, who have had considerable to do with this matter in other states. While this statment may seem strange to a good many, the reasons are perfectly obvious when properly understood. In the first place, the chinch bug disease is a natural one found in nature, and is not an artificial one. What we did was to collect the spores of this fungus and put them in boxes containing a great many living bugs. The air and the soil in these boxes were kept continually moist and warm, and, as a result, the spores readily germinated, and the mycelium of the plant found its way inside the bugs and fed upon them, killed them, and produced spores again on the outside of the bugs. It was these white, fungus-covered bugs that we distributed throughout the State to any one applying for them. The persons receiving these bugs were supposed to place them in boxes similar to ours, and keep them under similar conditions, and thereby develop large quantities of this fungous disease, and to scatter these throughout the wheat field. As a matter of fact, I have each year found that over half of the farmers do not go to the trouble of cultivating the disease, but simply scatter in their fields the bugs that we send them.

The spores for this fungus require for their germination practically the same conditions that the seed of your wheat or corn requires in order to germinate—that is, the spores must have a considerable amount of moisture in connection with heat, otherwise they will not germinate. If the chinch bugs are in large numbers and the weather is hot and very moist, these spores will germinate on the bugs, and the fungous plant will kill them in great numbers. But if the weather is hot and dry, or too cold, although it may be moist enough, then these spores will not germinate, and no agriculturist has the power to bring about the proper conditions in his wheat or corn field that will enable them to germinate. Hence you see that, although the farmer may obtain the chinch bug disease and scatter it in vast quantities throughout his field, if the climatic conditions are not right, the chinch bug disease will not take, and will do absolutely no good whatever.

But some may say that in obtaining these diseased chinch bugs from this office, and putting them in their fields, they introduce there the spores that will germinate when the proper conditions are right. I wish to say that it is very doubtful whether there is a wheat field or a corn field in Missouri that does not now naturally contain spores of this disease. I have been impressed with this fact every summer; because, almost invariably, when the person applying for the chinch bug disease sends to this office living chinch bugs that have been placed, as they should be, in a tin box containing no dirt, but some green vegetable matter, as, for instance, pieces of green corn, wheat, or grass, and that box closed up as it should be, perfectly tight, thereby generating moisture in the box from these green vegetables, that by the time these bugs reach me the box contains more diseased fungus-covered bugs than we return; thus showing that the spores were already there in his field, and all that was required was the proper amount of heat and moisture in order to enable them to germinate. Knowing these facts, I can do no other than to conscientiously advise the farmers of Missouri not to trouble themselves with obtaining and scattering this disease about their fields; but to rely entirely, as they will ultimately have to do, upon nature to bring about the proper climatic conditions for the development of this disease in their fields. Even if it were possible for the farmer in any way to develop the proper conditions in his wheat field, then there would be no ground for him obtaining this disease from any other source whatever.

Bear in mind that while I cannot advise agriculturists to trouble themselves with this chinch bug disease, because of the reasons above given, nevertheless, I am far from claiming that this disease does not do a great deal of good. The facts are, that when the chinch bugs are in the field in great numbers, or massed in places about the field, and warm rains appear, that this fungous disease spreads rapidly through the mass of chinch bugs, and kills them in great numbers, regardless of whether the farmer has ever introduced the spores into the field or not. This whole chinch bug disease then is one entirely out of and beyond the control of the agriculturists. I am perfectly well aware of the fact that it frequently happens that within a few days after we have sent out this chinch bug disease that the farmer will write back and tell me that he scattered the disease in the field, and that within two to three days the chinch bugs died in vast numbers, and were all but exterminated. Such letters are of daily occurrence during the chinch bug season; and any one knowing the nature of this disease, and of the chinch bugs, would know at once that the chinch bug disease that he received from us did not cause their death, because of the fact that the time that elapsed from the putting in of the disease to the death of the chinch bugs was far short of the possible time for the disease to take. This again simply shows that the proper climatic conditions had occurred to cause the disease already there to develop naturally among those bugs, and before he had introduced it.

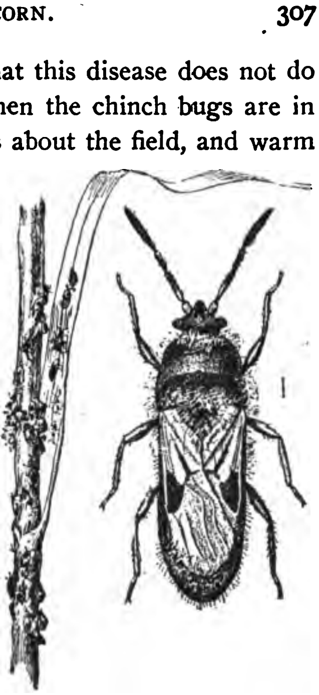


Fig. 55.—Chinch Bug, *Blissus leucopterus*, killed by the fungous disease, *Sporotrichium*. The mycelium is within the bug, and the fungous is starting to develop the white spores on the outside and ultimately cover it. (After Lugger.)

Another great error that farmers frequently make is due to the fact that the chinch bug, when it comes to shed its skin and transform from the last nymph condition to the adult, does so after climbing down between little clumps of earth and about the base of the plants, and there casts its skin. It frequently happens that this is done by vast numbers of chinch bugs within a day or two; and the farmer, if he has artificially introduced the disease into his fields, and happens to go out to observe whether the disease has caused any deaths among the bugs or not, notices these cast skins, and mistakes them for killed chinch bugs. This mistake is very readily made, and he immediately jumps to the conclusion that the chinch bug disease which he has recently introduced has killed vast numbers of his chinch bugs. But there is no need of saying anything further in regard to this chinch bug disease. I think that I have said enough now to enable the agriculturist to see the folly of wasting any time in trying to send for and cultivate and introduce the chinch bug disease into his wheat or corn field.

Chinch bugs cause a great deal of worry on the part of the agriculturist at about the time they are migrating from the wheat to the corn, and, fortunately, this is one of the best times in which to combat this insect. It frequently happens that at this time the chinch bugs migrate in a mass and in great numbers, leaving the wheat field and crawling in the direction of the corn field. When this is the case, whether the bugs are leaving your own wheat field or your neighbor's wheat field, and are moving in the direction of your own corn field, this corn field can be protected from the ravages of these bugs without any great amount of labor. This is done by taking advantage of the fact that this migration occurs almost invariably on foot; that even the adult chinch bugs in the migrating army do not readily take to wing; that these chinch bugs have great difficulty in passing over the loose and unprotected soil, such as a dusty road or a plowed field, and that the hot sun readily kills great numbers of chinch bugs that can find no place for shelter. While it is a well known fact that chinch bugs thrive better in hot and dry seasons and are easily killed or held in check by damp seasons, yet it is a fact that the chinch bugs cannot endure to any considerable extent the direct rays of the sun on a hot day. They are, for that reason, found in fields where plants are numerous enough to give them shelter, and are not apt to occur in fields where the plants are scattering and shelter from the direct rays of the sun not so easily obtained.

It is a fact that a migrating army of chinch bugs will be held in check in hot, sunny weather by a dusty road and die in immense numbers before many of them will succeed in getting across. We can take advantage of this fact, and, when we find the chinch bugs are about to migrate from the wheat field to the corn field, plow a belt around the corn field, or at least along the sides toward the migrating army of bugs. This plowed belt should be about ten feet wide. After plowing, the ground should be harrowed with a disc harrow, and rolled so as to break up all the lumps, and then reharrowed, dragging brush after the harrow so as to make this ten-foot belt just as dusty as can be made; then a log or a V-shaped trough should be drawn lengthwise along this dusty belt two or three times, so as to make furrows running lengthwise. Along one of these furrows, at least, it is well to dig little post holes, which can be readily done by means of a post-hole auger. When the bugs try to cross this barrier they will have great difficulty in even crossing the dust to these furrows. Once they reach the furrows, they will try to crawl out, and, if the furrows have steep and dusty walls, the chinch bugs will not succeed in getting over, but will crawl along the furrows and fall into the holes, where they may be killed by turning on kerosene or tar, or where they may be covered up and other holes dug between.

One will see that the chinch bugs find it almost impossible to pass this dusty barrier; that the hot sun striking them without any protection will kill vast numbers of them, and that just so long as it remains hot and dry this arrangement will form a complete protection for a corn field. It is well, however, to have one or two men, as is needed, to attend this barrier during each day, and, by means of a hoe, to fix the places along the grooves, where the chinch bugs may find places to escape, to see that the chinch bugs do not occur in too great numbers in the furrow or in the holes before they are killed, and to do the utmost not to allow any of the bugs to find places through which they may reach the corn field. It is not absolutely necessary to make these furrows along this dusty belt, although it is advisable.

If one does not make the furrows, or in case it should rain soon after the plowed strip has been made, or before the migrating bugs have been captured, one can turn coal tar in the form of a band the length of this dusty barrier and a few inches in width, and, as soon as dried, put tar on again, and so on, until the tar will not run down through the soil, but will remain on top, the chinch bugs will not cross this barrier or band of tar. If it should rain after you have made this dusty barrier and the bugs have collected in vast numbers about it, the rain will undoubtedly start the fungous disease among such a mass of bugs and will practically exterminate them, or you can maintain the barrier by means of the ribbon of tar.

When the chinch bugs collect in good numbers along the dusty barrier, or in the trenches, or along the coal tar barrier, or in case the farmer has neglected to make this barrier, and the chinch bugs have collected upon the first few rows of corn in immense numbers, then he should immediately stop all other work and at once spray those chinch bugs with either kerosene emulsion or five per cent kerosene and water mixture. In spraying the chinch bugs that have collected in the trenches or along the barrier, one would do well not to wet the dust any more than possible, but spray those places where the bugs are most numerous, so as not to destroy the dust as a barrier. It sometimes happens, although not often, that where the bulk of the chinch bugs making this migration are adults, with fully developed wings, and find themselves confronted with a barrier, they will take to wing and fly over, and in such cases they may collect upon the first few rows of corn, where they can be readily killed by means of kerosene emulsion spray.

It is a fact that chinch bugs die like magic before a spray of kerosene emulsion or five per cent kerosene mechanically mixed with water; and if we could always be sure that in this migration from the wheat to the corn field, the chinch bugs would collect in immense numbers upon the first few rows of corn and stay there long enough to allow of spraying them, this would be the ideal method of exterminating them from the corn field, or of preventing them from entering the corn.

An agriculturist should watch the chinch bugs, and when he finds them collected on the first few rows of corn or in masses along his barrier, he should be thankful, because he now has his bugs in the very best condition possible for obtaining his revenge. When the bugs collect in such places the agriculturist should drop every other work and spray these insects at once, especially if they are upon the fist few rows of corn, since they will soon spread through the corn; and when this happens, he is barred from any further method of killing them.

I would advise the agriculturist to purchase one of the new pumps with the kerosene attachment. These pumps are made by the better manufacturers, and cost very little more than the pumps without such attachments. They save an immense amount of time and labor, especially for such purposes as chinch bug extermination. The pumps do away with the necessity of making kerosene emulsion. All that is needed is to turn pure kerosene or coal oil in the receptacle attached to the pump for that purpose, and set the indicator at five per cent; put the pump in a barrel of water and spray without any further trouble. This five per cent mixture of kerosene kills the bugs readily, and does not injure the plants.

In spraying for chinch bugs it is necessary to touch every bug in order to kill it, because these bugs are killed by contact with the kerosene. This necessitates thorough work, and one must, therefore, spray on all sides of the plant that is infested with these bugs, but where the bugs have collected in this way in immense numbers, the agriculturist will be delighted to do the work and see the bugs die so rapidly and in such great numbers.

Where one has no modern spray pump with the kerosene attachment, then an ordinary spray pump may be used; but one must make kerosene emulsion. This is made in the following way: Dissolve one-half pound of hard soap (in case you wish to use soft soap one pound should be taken) in one gallon of boiling soft water; after the soap has been thoroughly dissolved and stirred through the water, remove this from the fire and add two gallons of common kerosene or coal oil, while the liquid is still hot. Remove the spray nozzle from your pump, put the pump into this mixture and pump the liquid right back into itself. This will churn it, and do so more thoroughly than any other process that we know of. This churning should be done vigorously and kept up continually for ten minutes, at the expiration of which time a complete emulsion will have been formed, and the liquid will have increased about one-third in bulk; hence the necessity of putting it into a larger receptacle than will exactly hold it in the beginning. After the emulsion has been made, add thirty-five gallons of water to it, stir thoroughly, and spray with this.

These two methods of killing the migrating army of chinch bugs when they try to enter the corn field (that is, by barriers or by spraying the bugs with kerosene), if followed out, are worth more to the agriculturist than all other methods combined. In one day, we, in this way, practically exterminate the mass of chinch bugs in the immediate neighborhood; and we do so at a time just previous to the depositing of eggs for the second brood, and, therefore, prevent that numerous increase which would otherwise occur. Hence it would not be unwise to again call your attention to the fact that when the chinch bugs come to migrate from the wheat to the corn they should be stopped by means of a dusty barrier around the corn field, or, if this cannot be done, you should spray them with some form of kerosene immediately after they occur in large numbers on the first few rows of corn.

THE ARMY-WORM.

Leucania unipuncta, Haworth.

INTRODUCTION.

The army-worm belongs to the great family of moths known as Noctuidae. There are a great many insects belonging to this family and closely related to the army-worm, which under certain conditions may, in the larva stage, leave the field in which they are feeding and march in a body, and hence it has come about that several distinct species of insects are popularly spoken of as army-worms when these marches occur. But there is one insect that is known as the true army-worm, and it is this insect alone that we will describe in this article. Let it be distinctly understood that the marching of the larvae of even the true army-worm in numerous masses, as they sometimes do, is, like the marching of the closely allied species, an entirely abnormal state of affairs.

The true army-worm is found in various places over the world, but, with the exception of Australia, where the insects cause some damage, that part of the United States and Canada east of the central portion of Kansas and north of Tennessee seems to be the region in which these insects occur in great numbers and cause such a vast amount of damage. Practically every year the army-worm causes several hundred thousand dollars damage in some portion of this region of the United States and Canada, and occasionally more or less throughout the entire region in the same year.

While we cannot say that the army-worm is on a whole so destructive as the chinch bug, yet within certain restricted areas it does, in certain years, cause more damage. The western part of the little state of Massachusetts lost upwards of five hundred thousand dollars by the ravages of one brood of this insect in a single season. About eight hundred thousand dollars worth of oats alone went down the throats of these army-worms in one season in the states of Indiana and Illinois. Just what the damage in any one year in the State of Missouri, due to the ravages of the army-worm has been, I am unable to say, but certain it is that many thousands of dollars are lost nearly every year in some portion of Missour as a result of the ravages of this insect.

Fortunately the army-worm does not occur in sufficient quantities to attract the attention of the agriculturist every year. Nevertheless, let it be understood that the army-worm is with us in our fields and meadows every year, but only in certain years do these insects multiply in such vast numbers as to destroy the food plants in their locality and cause them to march in armies in search of fresh food. When these marches occur the agriculturist has his attention called to it at once, and then wonders where these army-worms came from, and what becomes of them. As a matter of fact, very few agriculturists know anything about the life history of these little fellows. It is important, therefore, in order to intelligently understand the control of these insects, that he should at least know briefly the general outline of he life history and habits of these worms.

THE INSECT DESCRIBED.

The adult of the army-worm is a small, brown or fawn colored moth, somewhat speckled with black scales, and with a distinct white spot near the center of the front wing; the hind wings are of a lighter dusky color, with the outer margin and the veins darker or blackish. The expanded wings of these moths measure about an inch and a half to an inch and three-quarters. By referring to figure 57, *b*, one can obtain a good

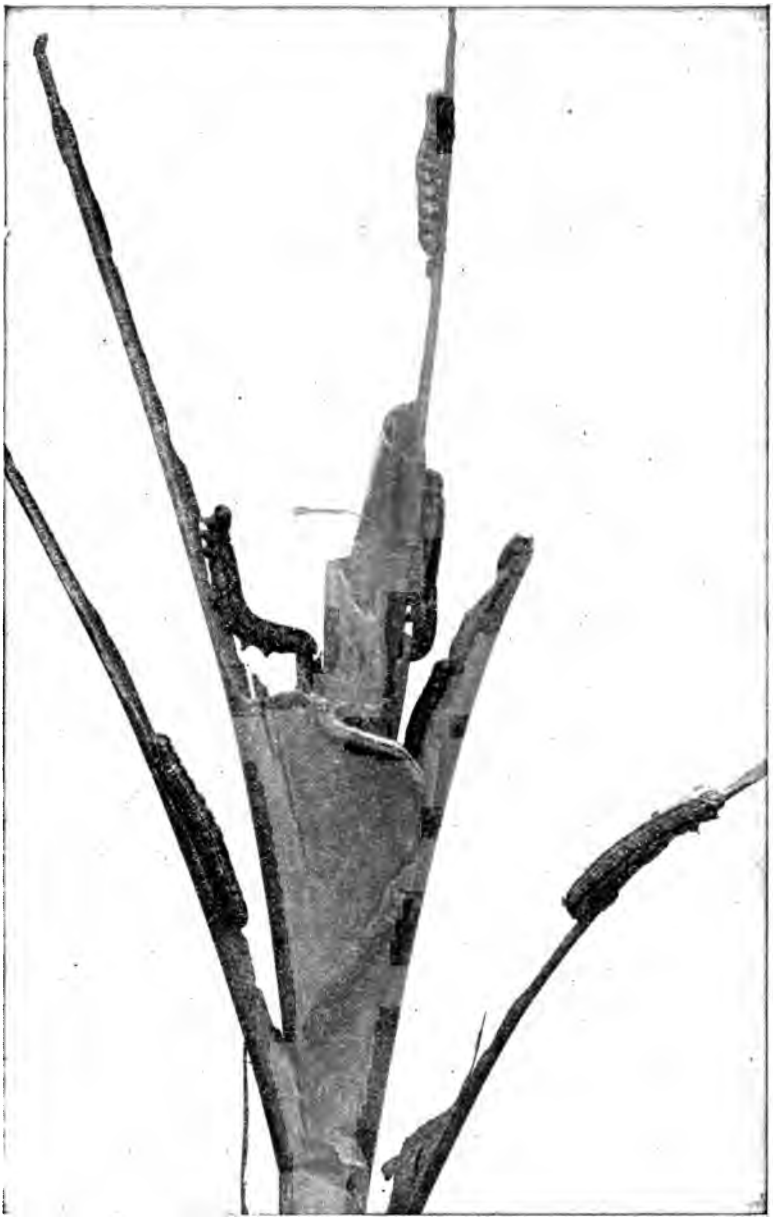


Fig. 56.—Army-Worm, *Leucania unipuncta*, at work on corn plant; nearly natural size. (From Slingerland.)

idea of the general size, shape and markings of these adults. This figure is natural size, and the one shown at *a* is also natural size, but has the wings folded, showing the insect at rest. In *c* the insect is shown twice its natural size.

The eggs are small, round and whitish or very light yellow in color, and are deposited in rows on grasses and other places, and smeared over with a glutinous secretion from the insect. Figure 57, *d, e, f, g,* shows these eggs as they appear on grass leaves when magnified two diameters. The larvae or worms, or caterpillars, as many people call them, are, when full grown, about an inch and a half in length, of a dark greenish color, with three stripes along each side. The head is of a greenish brown color, mottled with black, and this mottling is found more or less over the entire body. The stripes along the body are greenish yellow, with whitish margins. A good idea of the general appearance of a larva can be had by referring to figure 59, where the larva will be seen natural size, and to figure 58, where the larvae will be seen magnified twice their natural size. The pupa stage, which is passed under ground, is not unlike the pupa of a number of other insects, some of which you have probably removed from cocoons. The pupa is dark brown in color and measures about seven-eighths of an inch in length. Two pupae are shown, natural size at *a,* in figure 60, and two enlarged in the same figure.

THE LIFE HISTORY AND HABITS.

The adult moths appear in the spring and seek those places in the fields and meadows where the vegetation grows the rankest, and deposit their eggs in masses under the leaves of grass near the stem. The eggs are placed, as a rule, in a row, and are then smeared over with a glutinous substance that fastens the eggs together and to the leaf. The female, after laying a bunch of eggs in one place, passes on to another suitable place and deposits another bunch of eggs. Each female is capable of laying upwards of several hundred eggs, and herein lies one of the secrets that influences the development of these army-worms at certain times. The moths fly at night, and the depositing of the eggs by the female is done principally in the forepart of the night. During the daytime the moths remain concealed in some sheltered place.

The egg-laying season for Missouri varies from the middle of April in the southern portion of the State to the forepart of May in the northern part of the State. A corresponding difference occurs as regards the

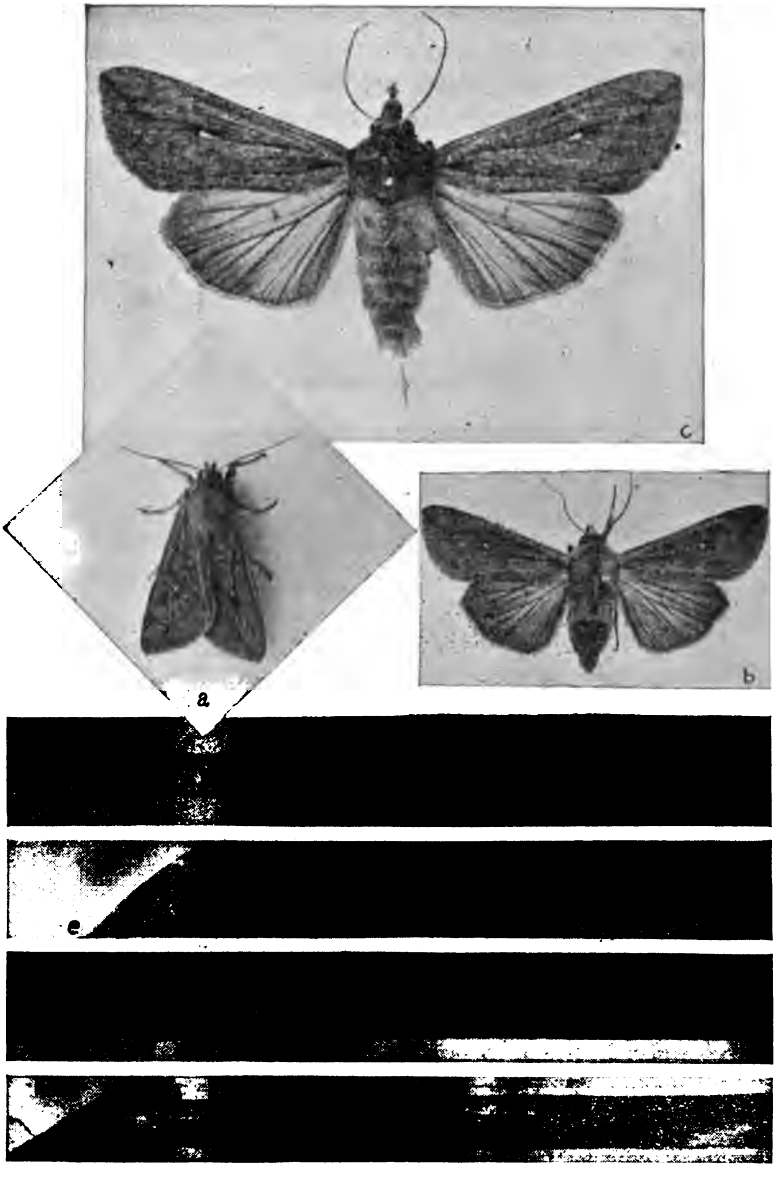


Fig. 57.—Adult Army-Worms, *Leucania unipuncta*, and their eggs: *a*, adult at rest, natural size; *b*, adult with wings expanded; *c*, adult, twice natural size; *d*, *e*, *f*, *g*, eggs of army-worm moths as they are laid in grass leaves, much enlarged. (From Slingerland.)

hatching and appearance of the various stages of these insects throughout this State. In central Missouri the eggs begin to hatch about the first of May, which is about one week after the eggs are deposited. The young larvae or worms, as soon as they hatch, feed upon the leaves of their food plant.

The plants that these insects will feed upon include especially the members of the grass family. They are not very particular in their menu, but, nevertheless, seem to prefer oats, corn, timothy, wheat, barley, rye, Hungarian grass, millet, sorghum and flax. While they seem to prefer these plants, they will eat onions, peas, beans and other garden crops.

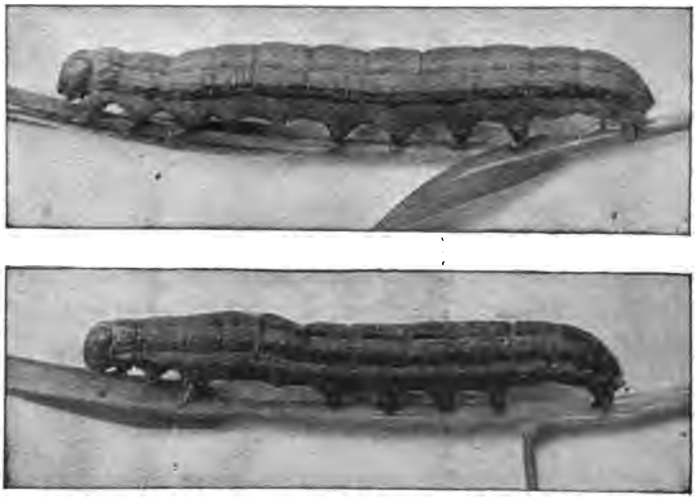


Fig. 58.—Light and dark varieties of Army-Worms, *Leucania unipuncta*, twice natural size. (From Slingerland.)

The worms seem to shun the direct rays of the sun and seek sheltered places. This is usually provided for them by the fact that the adult moths seek those places containing the rankest growth of grasses and other vegetation. The larvae feed especially on cloudy days and in the evening and night, and when disturbed they have a tendency to drop to the ground.

The grass in which these larvae hatch may be very badly infested without their presence being detected by the agriculturist. When these worms are very numerous, they succeed in eating the plants to such an extent that by the time they are half grown the proper amount of food in that locality has become too scarce for them, and they then take it into their little heads all at once to crawl in search of a fresh supply of food. In doing so these worms crawl in a mass, each one seeming to have taken it into his little head to perform this march at the same time. This marching of the worms in an army is brought about purely and simply by the scarcity of food in the place they had thus far been feeding. In these marches we find millions of worms massed together and all moving over the ground in the same direction, and it is this habit that has given these insects the common name of the army-worm. No one who has not seen an army of these worms traveling in search of a fresh supply of food can form any conception of the vast numbers, and of the destructive work that these insects are capable of causing. At such times the insects seem to be unusually hungry, and will utterly destroy nearly every green vegetable substance in their line of march, especially any members of the grass family, which, of course, includes our corn, wheat and other grains.

When these insects encounter a field of wheat or a corn field, they devour practically every green leaf and cut off the heads of the wheat. An ordinary marching army of these insects will completely destroy two acres of wheat or early corn in one day. When they attack a certain field, they usually march forward as fast as they are able to devour the plants. It is usually the case that these army-worms develop in low places about the meadows or fields where the plants are more thrifty, and should their number not be unusually great, they confine their feeding to this locality; but where they occur in immense numbers, as soon as they have obtained about half their larval growth, their appetites become so ravenous, and they devour so much more than they did previously, that the plants in this particular area are not sufficient to supply their food. It is in such cases, then, that the well known migration occurs. Whether the larvae have migrated or not, when they become full grown they enter the ground a little ways below the surface, and wriggle their bodies back and forth in order to pack the earth and make a little cell, and then presently change to pupae. The larvae usually require about twenty-five days in order to become full grown, and the pupae stage usually lasts about seventeen days. At the expiration of this time the adult moths emerge from the pupae. Hence in central Missouri we find these larvae, as a rule, marching about the first of June. At this time the corn is young and the wheat plant is in the milk stage, and should an army of these worms encounter

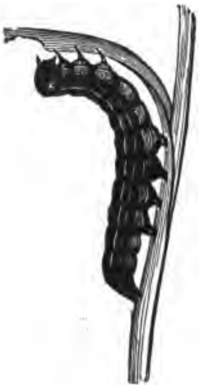


Fig. 59.—Larva of Army-Worm, *Leucania unipuncta*, natural size. (From Riley.)

a corn or wheat field at this time the amount of damage they will do cannot be appreciated by any one who has not actually seen their work. Two acres of corn or wheat will disappear down the throats of an ordinary army of these worms each day.

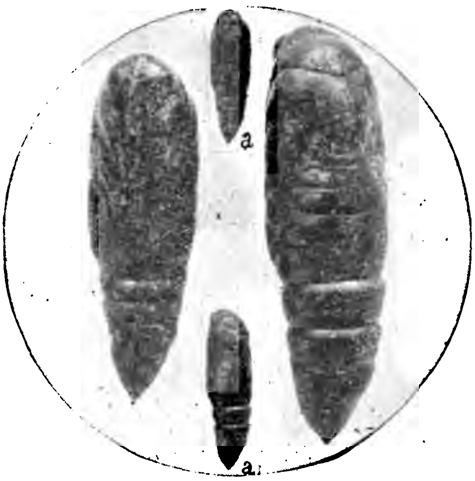


Fig. 60.—Pupae of Army-Worm, *Leucania unipuncta; a, a,* natural size; the other two enlarged about three diameters. (From Slingerland.)

Soon after the adults have emerged, they pair and lay eggs for another brood. These eggs are deposited in the same situations as were those for the first brood. If conditions are favorable for the development of the army-worms, this second brood of larvae coming from these eggs will be several hundred times more numerous than were the larvae of the first brood, and it frequently happens that this second brood is the one that does the most damage by marching in armies and attacking the corn at this season of the year. The wheat plant in Missouri usually escapes this second brood, but the corn plant suffers severely. By referring to figure 56, you will observe a number of larvae photographed in the act of stripping a corn plant. These insects are not quite natural size.

In due course of time the larvae of this second brood enter the ground in order to pupate, and the moths which hatch from this second brood appear during the forepart of August.

This second brood of moths again pair and lay eggs for a third brood of worms, which appear in the central portion of Missouri usually about the middle of August. It is not often that the migrating horde of the third brood of army-worms do very much damage here in Missouri. During the latter part of September or the forepart of October the third brood of adults appear. These adults seek sheltered places later in the fall, and there pass the winter hibernating as do the adults of the chinch bugs. They seek, as a rule, the loose bark on trees, secluded places under logs, and in piles of rubbish. We have no data to show that in central Missouri, at least, the winter is ever passed in any other stage. I have never been able to determine that the pupae ever fail to transform to adults in the fall if they are going to transform at all, neither have I been able to find that the larvae have ever failed to make pupae in time to allow the adults to emerge. It is quite different, however, with the states north of us, where there seems to be a good reason to believe that the winter is passed not only by the hibernating insects, but by the pupae, and occasionally by the larval stage. It will thus be seen that the army-worm in Missouri has three distinct broods each year, and that the winter is passed by hibernating adults only.

The army-worm has its ups and downs, but fortunately for the agriculturists of any given region, it is more often downs than ups. It is a well known fact that the appearance of army-worms in great destructive numbers never has occurred in any given locality for two consecutive seasons. While the army-worm is with us in small numbers every year and can be readily found by a person searching for them in pastures and meadows and wheat fields, yet the insect is held in bounds by a number of foes, some of which will be discussed later on. It appears that it is only about once out of ten times that these natural enemies fail to do their duty, but when they fail, the army-worms succeed in multiplying sufficiently to cause the larvae to take upon themselves the habit of marching in great masses, and practically devour every green thing in their path.

NATURAL ENEMIES.

While the army-worms are greedily preyed upon by a number of different birds, especially the robins and thrushes, and while poultry of all kinds thrive on this luxuriant food, and also while certain parasitic fungi and bacteria also kill numbers of the larvae and pupae, yet the great war

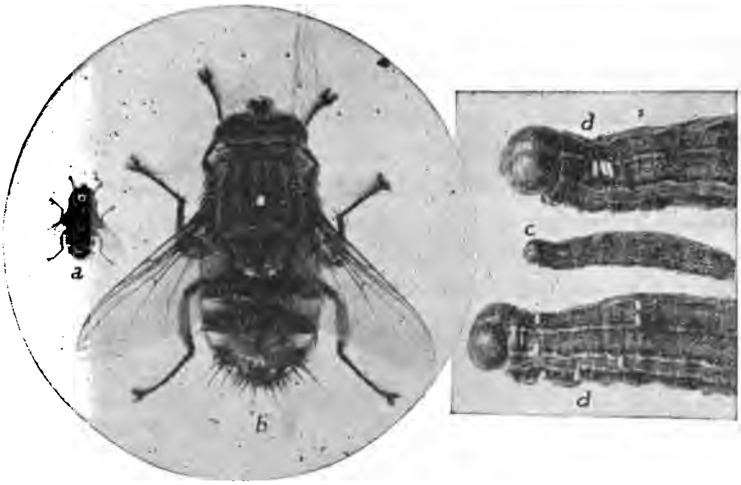


Fig. 61.—The Red-Tailed Tachina Fly, *Winthcmia 4-pustulata*, a parasite on the Army-Worm; *a*, the fly, natural size; *b*, same, much enlarged; *c*, army-worm on which the fly has laid eggs, natural size; *d*, parasitized army-worms, enlarged. (From Slingerland.)

waged upon these insects is particularly due to the presence of certain parasitic ones. Some Ichneumon flies sting the larvae and deposit their eggs within their bodies, and the resulting grubs feed upon them and kill them. Certain parasitic flies especially do an immense amount of good in holding these army-worms in check by depositing their eggs upon them, and the grubs which hatch work their way within and feed upon the tissues of the army-worms. Probably every agriculturist who has observed the army-worm marching in great numbers has had his attention called to the presence of vast numbers of flies that buzz around or about the marching army, and have caused him to wonder why and for what purpose they were there. One of these flies is shown in figure 61, natural size at *a*, and greatly enlarged at *b*. A part of an army-worm on which you will see the white eggs of these flies is also shown in figure 61, natural size at *c* and enlarged at *d*. They are to be found in great numbers wherever the army-worms occur in quantities, such as is the case when on the march, and they may be seen darting down and depositing an egg upon the body of the doomed army-worm. The agriculturist then should be delighted to see these flies about the fields that are infested with army-worms, for it indicates to an almost certainty that the next brood of army worms will be so reduced as to not become especially troublesome.

REMEDIES.

Ordinarily for any given locality, it is not especially necessary to take any means of fighting the army-worm each year, because it does not ordinarily occur in that particular locality in sufficient quantities to warrant such procedure; and from this very fact is due, no doubt, the want of a knowledge on the part of most of the agriculturists in regard to the habits, life history and methods of controlling this insect; while those insects that are injuriously abundant each year, the agriculturist soon learns to combat. Unfortunately the army-worms may be very numerous in a meadow or in the low and rank growing places of a grass field and yet not attract any attention from the owner until the larvae have become about half grown, when he will suddenly discover that the plants in such places are being destroyed, and by that time the worms have undoubtedly taken it into their little heads to seek fresh feeding ground. If an agriculturist be fortunate enough to discover the presence of vast numbers of army-worms in the meadows or fields, he should resort to some means of destroying them there, and not allow them to migrate or march to other places. It is possible to spray the badly infested areas with strong arsenical poison, or kerosene mechanically mixed with water, as described under chinch bugs, and in that way practically exterminate the colony, but, nevertheless, it is a rare thing that such a discovery is made in time. The next best method is to plow a few furrows around the badly infested area. These furrows should be as deep as possible, and should have their vertical sides away from the infested area. Post holes should then be dug every six or eight feet along these furrows. When these army-worms start to migrate, as they are sure to do when they occur in quantities sufficient to attract the attention of the agriculturist, they will not be able to readily get across these furrows. They are rather clumsy worms, and once they find they cannot ascend the perpendicular walls they will walk along the furrows in the hope of finding some escape, and will tumble into the holes, where they may be killed by sprinkling with kerosene or by burning them. I have seen hundreds of bushels of army-worms captured in such holes. This method absolutely prevents further damage by the army-worms, and, as a rule, up to the time of marching the damage from army-worms is not a great one; hence it is a comparatively easy matter to confine the army-worms by this method to a small area and prevent the destruction of large crops. In case the army-worms are on the march or have escaped from the original badly infested area, or in case they are upon a neighbor's premises, and you have fear of their ultimately marching upon your fields, then you should plow furrows about the fields you wish to protect, and in this case the vertical side should be towards the field to be protected. Holes should be dug along these furrows every few feet and the same method of killing the worms resorted to as given above. In case there be some doubt as to whether the worms are coming to your field or not, the furrows may be readily plowed and the digging of the holes left until you are satisfied the worms are approaching. This furrow and post-hole method has such an advantage over the coal tar, the lines of fire or the dragging of a log through the furrow, that it seems to me unnecessary to discuss them.

THE FALL ARMY-WORM.

Laphygma frugiperda, S. and A.

INTRODUCTION.

While, as a rule, the true army-worm does not occur in devastating numbers in the fall of the year, another insect, the fall army-worm, does frequently occur in immense numbers in the fall of the year, and, like the true army-worm, when the proper food in the locality in which it was born gives out and the insects occur in sufficient numbers, they migrate in a mass and march in search of fresh fields. This has given the name of army-worm to this particular insect also, and since this migration in great armies occurs in the fall of the year, it has been called the fall army-worm. The insect is, to be sure, closely related to the true army-worm, but can be readily distinguished from it.

The moths differ from one another greatly, but are, as a rule, of a light gray color, with the hind wings more or less whitish and semi-transparent. The insect is a little smaller across its expanded wings than the true army-worm, as a rule, not greatly exceeding one inch. In collecting a good many of the moths, one will notice that they vary from the color just described to those individuals that have a considerable admixture of bluish white. The markings on the fore wings are quite different from those of the true army-worm. A good idea of the general appearance, size and variation of the fall army-worm may be had by looking at figure 63.

The larvae or worms are also quite different and readily distinguished from the true army-worm. They are not quite as large when they are full grown. The bands along the sides are broader, and the insect is spotted with small dark or black tubercles, on the end of each of which a short black hair is found. The head has a V-shaped mark upon it, which is not found on the true army-worm. The worms, when full grown, are a little over an inch in length, with a brown head, the body striped with greenish-gray above, and a broad dark stripe along the sides, below which is a band of dull yellow. Underneath, the insect is greenish-gray, and on the back are three lines of yellow. A good illustration showing the general size and characters of this larva will be found in figure 62.

The eggs are deposited by the parent moth more frequently on the under side of leaves, on small twigs of trees and on bushes in the neighborhood of low meadows, as well as on the rank growing vegetation. There are also three broods of this insect each year in Missouri, but unlike the true army-worm, the larvae of this insect rarely occur in great numbers until the third or fall brood, by which time the insects may become so extremely numerous within certain areas as to destroy the plants upon which they are feeding, and therefore be forced to migrate in a mass.

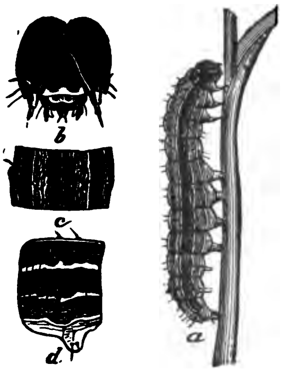


Fig. 62.—The Fall Army-Worm, *Laphygma frugiperda*: *a*, larva, natural size; *b*, its head, enlarged; *c*, *d*, its body segments, enlarged. (From Riley.)

These insects, if they attract the attention of the agriculturist, usually do so in the late corn and fall wheat, to which they march from nearby meadows. If the green wheat or other grains or grasses be unhandy, they will attack corn and devour not only the leaves but eat of the stem, and frequently eat their way through and about the green ear of corn. In the great majority of cases, however, these fall army-worms enter the wheat fields in the fall and devour the young green wheat. Agriculturists frequently become very much alarmed by the presence of vast numbers of these worms eating the wheat, but frequently they do much less damage than the agriculturist is, as a rule, disposed to admit. The fact of the matter is, that these larvae may eat off very thoroughly every vestige of wheat above ground in the fall of the year, and yet the wheat suffers very little, if any, from such an attack. The wheat will come up in the spring as if nothing had happened, and may even grow considerably in the fall after the worms have ceased to work.

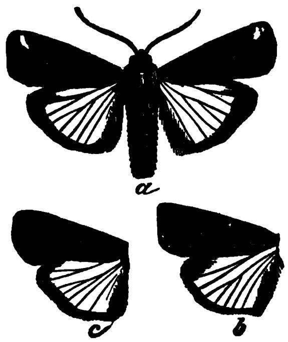


Fig. 63.—The Fall Army-Worm, *Laphygma, frugiperda*; *a*, adult moth, natural size; *b*, *c*, wings showing variations, natural size. (From Riley.)

Like the true army-worm, the larvae of the fall army-worm, in their various broods, enter the ground in order to pupate. The winter, however, is passed in the pupa stage, rarely in the adult stage.

While the true army-worm feeds upon almost all the members of the grass family, with an occasional change of diet, the fall army-worm seems to be broader in its selection of food, and while the grasses, including, of course, the grains and corn, form its principal diet, yet the insect has been known to attack the fall fields of turnips and ruin them, and also various other succulent garden vegetables and plants, even feeding upon the leaves of certain trees.

NATURAL ENEMIES.

Why it is that the first or the second brood of the true army-worm is so great in numbers while the first and second brood of the fall army-worm is so reduced in numbers as to attract no attention is something which we do not understand. One would expect that the birds and predaceous and parasitic insects, that succeed in preventing the development of the fall army worm, would likewise check the early development of the true army-worm at that season of the year. The facts are, however, that the fall army-worm seems to increase in numbers with each succeeding brood throughout the season, so that it is only the fall brood that ever becomes unduly numerous; while, on the other hand, the true army-worm frequently becomes unduly numerous in the spring and early summer broods, and then is held in check and prevented from being too numerous by its natural enemies. Some birds that prey upon and devour so greedily the larvae of the true army-worm, also feed just as readily upon the larvae of the fall army-worm. The same may be said of the parasitic insects that destroy them. Like the true army-worm, this fall army-worm does not occur in damaging quantities every year, neither has it occurred in damaging quantities in one locality in two consecutive seasons.

REMEDIES.

The fall army-worm may be prevented from spreading away from the badly infested areas in our meadows or fields, or may be prevented from entering our fields, by the same methods that were described under the true army-worm. It is frequently an easy matter to successfully kill vast hordes of these larvae when in the field by the simple process of rolling the field. This should be done when the field is hard enough, and comparatively free from stones or rough places, so that the insects will be crushed while the grass or wheat will not be injured in any particular way. Late plowing will destroy vast numbers of these insects in their winter quarters, and the continual rotation of crops will have a great deal to do towards checking their undue development.

It would also be a good plan to turn poultry of all kinds into the infested fields and allow them to devour the worms. It sometimes happens that in the marching of the fall, as well as the true army-worm, that they are detected trying to cross a road or lane, and in such cases one can crush them in immense numbers by drawing a roller back and forth over the area over which they are marching.

Where these larvae occur in gardens or fields containing late vegetables, they sometimes do considerable damage, and will also attack the flower garden and devour sweet peas, pansies and other varieties. Where garden vegetables are in the immediate vicinity of fields badly infested with these worms, the garden plants may be protected either by the plowing of furrows, or by scattering rows of poisoned bran about the field. This will necessitate, however, the keeping of poultry out of such patches, otherwise the poultry will be killed. The poisoned bran may be made by mixing a pound of Paris green or a half pound of pure arsenic with a bushel of bran. This should be stirred up thoroughly in a dry condition, and then made into a thick dough by means of sweetened water. This should then be scattered about the plants, or along the sides of the garden nearest the worms.

THE CORNWORM.

Heliothis armiger, Hubn.

The corn worm is the larva or worm found in the ear of corn, and is known not only to the person raising corn in the field or the home garden, but is also known to every housewife who has ever attempted to take the husks from sugar corn. This same insect is also known as the "ear-worm," on account of its presence in the ear of corn, and is also known as the "boll-worm" in the south, on account of the fact that the insect burrows in the cotton boll and feeds upon the developing seed.

These insects not only feed normally upon the corn plant, but they attack and injure, besides the corn and cotton above referred to, the fruit of the tomato, inside of which they will excavate chambers, while feeding upon the pulp, and will also feed upon the tobacco plant, where they injure especially the buds. They also feed upon the bean plant, in some sections of the United States, being the principal injurious insect attacking this plant. They likewise feed upon pumpkin, squash, peanuts, cowpeas, peas, peppers, asparagus, jimson-weed, morning-glory, geranium, sunflower, gladiolus, poppy and peach. In fact, the range of food plants that this insect will attack is much larger than I have indicated.

These insects do more injury to the corn at large than is generally supposed, because we are accustomed to losing a certain per cent every year from his insect. It is not, however, so much the actual amount of kernels of corn that these insects eat, as it is the damage which they do by causing the ears of corn attacked to decay by allowing the various bacterial and fungus diseases to attack it. They greatly annoy the housewife who, when she comes to take the husks from the ears of sugar corn, almost invariably finds one or more of these "ugly" worms, the presence of which is not only disgusting to her, but the upper third of the ear is usualy injured to such an extent that she is compelled to break it off and throw it away. In most localities of the United States sugar corn is attacked by these insects to such an extent as to make it almost impossible to purchase on the market corn without having the great bulk of it infested with them.

The great damage that these worms cause to corn comes when the corn grower tries to cut up his corn and put it into the silo, preparatory to making ensilage. When this corn is cut up it is very apt to contain a great many of these worms, and they are introduced into the silo with the corn. The various bacterial and yeast plants which develop in this corn and sour it and convert it into ensilage, thus preserving it, are not able to convert or preserve the animal matter which has been there introduced in the form of corn-worms. These insects then start to decay, and as soon as they are thoroughly under way the entire corn decays, and what would otherwise have been ensilage is ruined. My observations lead me to believe that in every case of failure to make ensilage the cause can be traced directly to the presence of large quantities of these corn worms in the corn at the time it was cut up and placed in the silo.

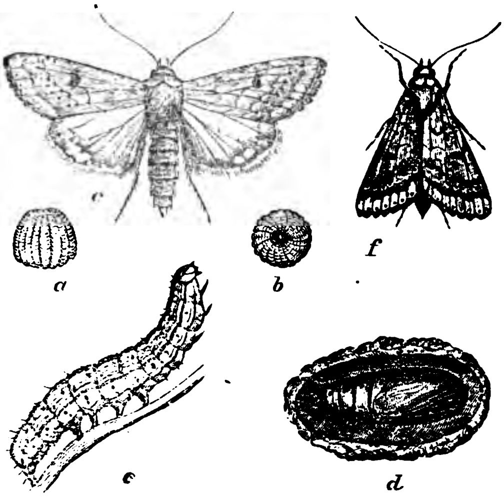


Fig. 64.—Corn Worm, *Heliothis armiger;* *a, b,* eggs greatly enlarged; *c,* larva; *d,* pupa; *e, f,* adulta.

The adult of the corn worm is a greenish-yellow moth, with a black spot in the middle of the front wings and with various olive markings across them. One of these moths is represented, natural size, in figure 64, *e,* with its wings expanded, and at *f,* with its wings closed, as the insect appears when at rest. These moths deposit their eggs in various situations, upon various plants upon which the larvae feed. They also deposit their eggs in the silk of the corn, and occasionally upon the leaves, and the larvae, when they hatch, may feed upon the leaves of the corn plant, or upon the husks or the silk, but more frequently enter the ear and feed upon the developing kernels of corn, where they mine down towards the base of the ear, but, as a rule, do not reach the base, but are contented with ruining the upper half of the ear. There may be more than one of these larvae in an ear of corn, but in the great majority of cases only one larva is found.

When these larvae become full grown they are from one and one-half to two inches in length, of a pale green or dark brown color, with dark stripes and with a yellow head. One is represented in figure 64, *c.* When full grown larvae they leave the corn plant, or other plant upon which they have been feeding, and enter the ground for an inch or two, and then, by wriggling their bodies, pack the earth away so as to make little earthen cells, line them with a little silk, and inside of these earthen and silky cocoons transform to pupae, one of which is represented in its cocoon in figure 64, *d.* There are in Missouri three broods of these insects each year. The winter is passed as a pupa inside the cocoon under ground. In the spring these pupae transform to adults, which fly about and lay their eggs during April, each female laying from two hundred and fifty to five hundred eggs. Two pictures, representing the eggs of this insect magnified, can be seen in figure 64, *a, b*. The larvae hatching from these eggs become full grown in about four weeks, sometimes sooner, and the pupa stage for this brood lasts from two to three weeks, by which time another set of adults emerges and deposits eggs for another brood.

Late corn suffers more from the attacks of these corn worms than early corn, because of the fact that the second or third brood is in greatly increased numbers. These insects, both in the larva and adult condition, are preyed upon by many parasitic and predacious insects and birds. There seems to be no satisfactory remedy or means that we can employ to prevent these insects from getting into corn or of killing them once they are in a large field. In a small home patch of sugar corn the matter becomes more simple, because one can more readily pass through what little sugar corn he would be apt to have, and by opening the ends of the ears of corn, take out these larvae and kill them without injuring the corn in the least. By passing through once a week in this way one can prevent any particular damage by this insect, but, of course, such a method as this would be an impracticable one in a large field. The only method that we have for fighting this insect in a large field is the use of the trap-lantern, and yet it is still an open question as to whether these trap-lanterns are, even here, economically successful. The adult insects are attracted very readily to light, but the males are by far the most predominant in these traps, and what females we do get have, in the great bulk of cases, already deposited their eggs, and hence out of the great number captured but few of them are females in the egg-laying condition.

One can very readily tell whether these insects are in the field in undue numbers or not, and in case they are, it is advisable not to attempt to make ensilage from that corn.

GRASSHOPPERS.

There are many species of the short-horned grasshoppers, or Acrididae, that get into corn, usually from adjacent grass fields, and feed upon the corn plant by eating of the leaves, tassels, silk, husks about the ear, and sometimes eating through the husks into the ear, thus causing the same to decay. Usually our grasshoppers are not numerous enough to cause any serious injury to the corn crop as a whole. In most instances, where they get into the corn field so as to cause any noticeable attack, they do so late in the season when the plant is sufficiently developed to withstand any ordinary work of these insects.

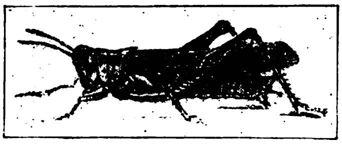


Fig. 65.—The Red-Legged Grasshopper, *Melanoplus femur-rubrum*; natural size.

Once in a while some of our common grasshoppers become unduly numerous, and then get into corn fields in such numbers as to strip the leaves and prevent the proper maturing of the ears of corn that would not otherwise have been injured, and they will then ruin a large per cent of the ears by eating through the husks and allowing the kernels to become attacked by fungous and other diseases. To be sure, many cases have occurred where these insects have absolutely ruined a corn field in this State, but the chances are that such a case will not happen again, as the country is becoming so thoroughly settled that the immense development of grasshoppers is not likely to be again presented. Some of our common grasshoppers occur occasionally in sufficient quantities to leave grass fields in large bodies and fly some distance to neighboring corn fields, where they alight and devour the corn plant, but such cases are rare.

Our most common grasshopper is shown, natural size, in figure 65. It is known as the Red-legged Grasshopper. Another grasshopper which becomes more abundant later in the summer, and which is much larger in size, is represented natural size in figure 66. This is known as the Bird Grasshopper, and occasionally this insect occurs in sufficient quantities to seriously injure corn fields. The Olive Grasshopper, represented natural size in figure 67, and the two striped grasshoppers, represented natural size in figure 68, are two common species that we frequently find eating of the corn plant, but they are not liable to cause so much trouble as the two former species. Of course, we have a good many other grasshoppers that one will find occasionally in corn fields, but the four I have mentioned seem to be the more common ones.

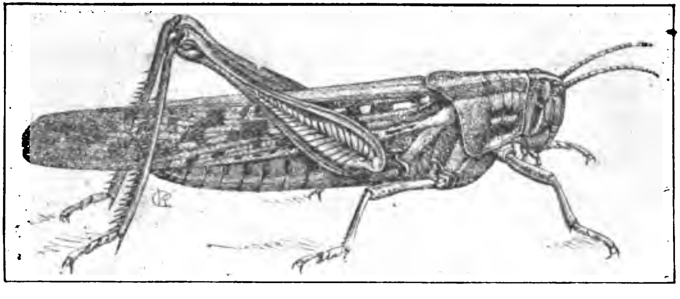


Fig. 66.—The Bird Grasshopper, *Schistocerca americana;* natural size.

Grasshoppers lay their eggs in the latter part of the summer by pushing their abdomens into the ground and filling the cavity thus made with eggs. These eggs are usually deposited in grass fields. If not in a grass field, they are deposited, as a rule, in the open and not in or about timber. These eggs remain over winter and hatch in the spring into young grasshoppers that look like the adults, except they are smaller and have no wings. Everybody, however, recognizes these insects when they first hatch as grasshoppers. To be sure, the grasshopper eggs are fed upon by a number of parasitic and predacious insects and some other animals, and are subject to injury from other causes, but when placed so as to not be in the shade, they stand a good chance of hatching.

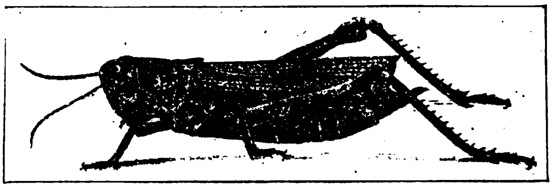


Fig. 67.—The Olive Grasshopper, *Melanoplus differentialis;* natural size.

It sometimes happens that the early warm days of spring cause a good many of the grasshopper eggs to hatch, and extremely cold weather following will kill them. This was the case to a marked degree this year, where in some localities apparently all the grasshopper eggs of certain species hatched some time before settled spring weather appeared and were killed by the following freezes. These young grasshoppers feed normally upon grass of various kinds, also upon certain weeds, and when in unusual numbers, will injure the grass fields to such an extent as to attract attention. They may get upon almost all kinds of grass, farm, and orchard plants, and eat off the leaves, or the fruit, or the bark, as the case may be.

It will be very exceptional, indeed, if grasshoppers in Missouri ever become again so numerous as to warrant their capture by means of the hopper dozer. These hopper dozers are nothing more or less than very wide pans, drawn upon runners, and having the back and sides made of canvas or some other material, so that when this hopper dozer is pushed through the field, the grasshoppers will fly up and back and strike against the canvas and drop down upon one another, where they will accumulate in a mass, and can be dumped out

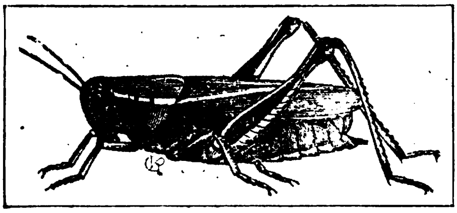


Fig. 68.—The Two-Striped Grasshopper, *Melanoplus bivittatus;* natural size.

on the ground and another collection made. When the grasshoppers are not numerous enough to make this method perfectly satisfactory, the pan is sometimes filled with kerosene and the back covered with kerosene.

The most successful method of fighting grasshoppers now seems to be by the use of what is known as the "Criddle mixture." This mixture is made in the following way: To a barrel of fresh horse manure thoroughly mix a pound of salt and two pounds of Paris green, or one pound of powdered arsenic. If this mixture is made of perfectly fresh horse manure the salt may be omitted, but if the horse droppings are not perfectly fresh, the salt must be added. This Criddle mixture, so called, should be placed in handfuls about the corn field where the grasshoppers are doing the most mischief, and it will attract them for several feet. They will feed upon it in preference to any other known substance, and will be killed by the arsenic, which has been thoroughly mixed with it. This same Criddle mixture, is, of course, valuable in connection with other plants that are being injured by these insects.

THE ANGOUMOIS GRAIN MOTH.

Sitotroga cerealla, Oliv.

This minute moth is well known to all corn raisers on account of its injury to corn and wheat while in the field, as well as to the grain while stored in the granary. The insect was originally an imported one, having come from the Province of Angoumois, France, where its injuries are well known. It has now spread throughout practically all of the grain-growing regions of the United States. Two years ago it seemed to be unusually abundant in the southwestern part of Missouri, and a great many inquiries, with specimens of the insect and its work, were received by me at that time.

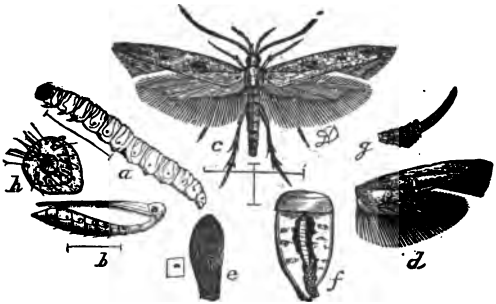


Fig. 69.—The Angoumois Grain Moth, *Sitotroga cerealla*; *a*, larva; *b*, pupa; *c*, adult moth; *d*, wing; *e*, egg; *f*, larva within grain. The lines near each figure indicate its natural size, most figures being enlarged. (From Howard, U. S. Dept. Agric.)

The adult moth is a small, grayish-brown insect, about half an inch across its expanded wings. The hind wings are beautifully bordered with long delicate hairs. The insect is represented in figure 69, *c*, enlarged about three diameters, the hair line just below indicating its natural size. The moths emerge in spring from granaries and other places where seed and grain has been stored, either husked or threshed, or in the shock, and fly to the corn and wheat fields and there deposit their eggs in the ears of corn, and earlier in the heads of the developing wheat at about the time the wheat is in the milk stage. Each female lays a large number of light-red eggs, one of which is shown greatly enlarged in figure 69, *e*.

These eggs hatch in a few days into minute larvae or caterpillars, which eat their way through into the developing kernel of corn or wheat, feeding within upon the starchy material. When this corn ripens and is cut and stacked in shocks, the larvae soon reach their full development, by which time they are upwards of a half inch in length, and of the general appearance and shape represented in figure 69, *a*. They then spin a little cocoon within the hollowed out kernel of corn and transform to pupae, one of which is represented in figure 69, *b*. These pupae transform to adults during the latter part of July, and the moths work their way out and escape. They soon pair and deposit their eggs for another brood upon the corn or grain from which they have emerged.

If the corn after being cut is soon carried into the barn, or is husked or shelled and stored away in bulk in the granary, these moths that emerge from the seed deposit their eggs there upon it, or in case the corn is not husked or shelled, deposit it upon the ear under the husk at the upper end. The larvae constituting this second brood reach maturity during the fall and hibernate within the kernels of corn, changing to pupae in the spring, and the adult moths appear in May or early June, and seek the new corn and wheat fields. If the grain be stored in warm granaries, there may be as many as four broods during the year in such cases.

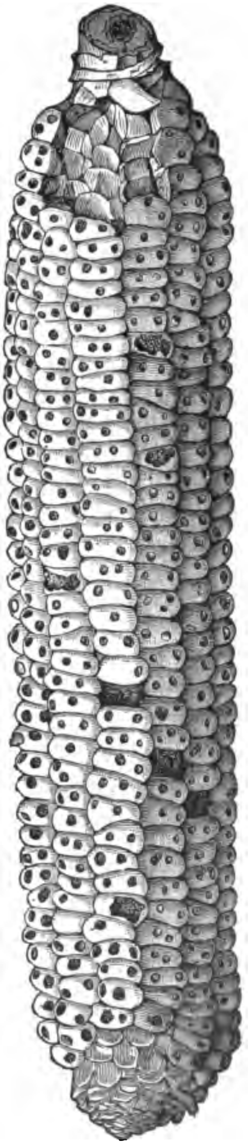


Fig. 70.—Ear of corn showing work of the Angoumois Grain Moth.

It appears that the adult moths, which deposit their eggs in the wheat fields in the early summer, come from the nearby barns and other places where grain is stored, either threshed or unthreshed.

It is advisable not to have the corn or wheat standing in the fields in shocks any longer than is absolutely necessary, because the moths will emerge from such places and be scattered through the neighborhood. Neither is it a good plan to store the corn in an unhusked condition for the same reason. If the corn be husked and shelled soon after it is cut and stored in bulk in the granaries, the moths that will come out from the kernels of corn that are situated very far below the surface will not be able to crawl out of the stored seed, and will, therefore, be prevented from pairing and depositing eggs, which will hatch and produce another brood of larvae. Of course, the moths that happen to be in the upper or outer tiers of the corn will escape and fly about the bin and pair and lay eggs upon the corn for succeeding generations. These moths that can thus continue the species and cause the destruction of the seed can be readily killed by the use of bisulphide of carbon, which you will find described under the head of the Grain Weevil.

The amount of injury to corn sustained by these little moths is sometimes quite considerable. In badly infested cases the corn has been known to lose forty per cent of its weight and seventy-five per cent of it farinaceous matter. Corn or wheat badly infested with these insects is not suitable for milling purposes, nor for food for man, and the kernels that are hollowed out to any great extent will not germinate, and hence the seed is greatly damaged for germinating purposes. Figure 70 shows an ear of corn badly infested with this insect. Such corn is not suitable for either food or seed purposes.

Where one has suffered more or less from these moths, the careful following out of the plans suggested under the grain weevil will prevent future trouble. These insects not only infest corn and wheat, but also other small grains, and develop and breed generation after generation in corn stored in cribs and other places about the farm. Hence it is necessary, in order to combat this insect in corn, to attend to its destruction in other places, especially in the wheat. It must be understood, however, in this connection, that there is no way of combating this pest in corn or other grains stored in the open bin or crib.

For methods of fighting this insect, see under the Grain Weevil.

THE GRAIN WEEVIL.

Calandra granaria, Linn.

This minute beetle is about one-seventh of an inch in length, and of a glossy, chestnut-brown color; the head is prolonged into a beak, on the end of which the mouth parts are placed, the angular antennae being situated on the upper part of the beak. By referring to figure 71, *c*, you will be able to obtain a good idea of the appearance of the insect when seen under a magnifying glass, and just above it the outline of one of the beetles natural size.

These beetles, fortunately for the agriculturist, infest the corn only when it is stored, and will not be found infesting it in the field. These beetles eat holes in the grain for food purposes as well as for depositing their eggs, which they push down in some of the holes which they have eaten. The larvae hatching from these eggs are small, footless, fat, grub-like creatures, one of which is represented, greatly magnified, in figure 71, *a*.

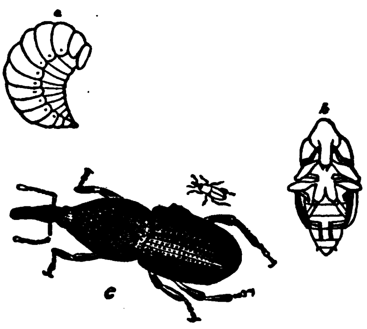


Fig. 71.—The Grain Weevil, *Calandra granaria*: *a*, larva; *b*, pupa; *c* ,adult. All greatly enlarged, except the outline of small beetle just above the large one. (From Howard, U. S. Dept. Agric.)

These larvae feed within the kernel, mining it out, and when they become full grown transform to the pupae stage within the kernel, similar to the grain moth previously described, but not, however, by first making a little cocoon, as do the moths. Presently these pupae transform to the adult beetles, and then they eat their way out of the grain and lay their eggs for another brood. It requires about six weeks from the time the egg is deposited until the adult stage is attained.

These insects breed generation after generation in the stored corn, and under favorable conditions in this State we find upwards of five broods a year. These insects multiply very rapidly, the adult female beetle laying a great many eggs and laying these during quite a long period. These beetles are also much stronger and more powerful than the grain moth, and for that reason are able to escape from the stored corn at greater depths. For this reason also they are able to do more injury.

REMEDIES.

The Angoumois grain moth and the grain weevil, as well as a number of other insects that feed in stored grains and seeds, may be readily killed by proper fumigation with bisulphide of carbon. The following method should be strictly adhered to: In the first place, it must be distinctly understood that in order to kill these insects in stored seed or grain, the seed must be confined in a tight room, granary or box, as the case may be. If such places are not tight, then every crack and crevice must be stopped up with rags or by other means, because the first essential is to have a close place where there will be no possibility of the fumes escaping. The door should also be looked after and arranged so that it may be closed without leaving any cracks. The bisulphide of carbon is then to be placed in shallow basins, and these are to be placed *on top* of the seed. The bisulphide of carbon may be thrown on top of the corn, or rags may be saturated with it and these be placed on top.

It is absolutely important also that this bisulphide of carbon be placed *on top* of the seed to be fumigated, because the fumes from this bisulphide are much heavier than the air, and therefore settle. If the bisulphide is allowed to evaporate on top of the corn, the fumes will penetrate down all through it, but if the bisulphide be placed near the floor it will evaporate, but the fumes will not rise and the bulk of the corn will not be fumigated at all.

The amount of bisulphide to be used depends upon the nature of the room or bin holding the corn, and also upon the maturity of seed to be fumigated. As a general rule, if the bin, granary or room be very tight, as will be the case if matched boards are used, then two pounds of bisulphide of carbon will properly fumigate every one hundred bushels of corn. If the room or bin be not made of matched material, more bisulphide of carbon should be used. If the room or bin be a comparatively large one for the amount of corn it contains, then one should use two pounds of bisulphide of carbon for every five hundred cubic feet of space, regardless of whether this space contains corn or not.

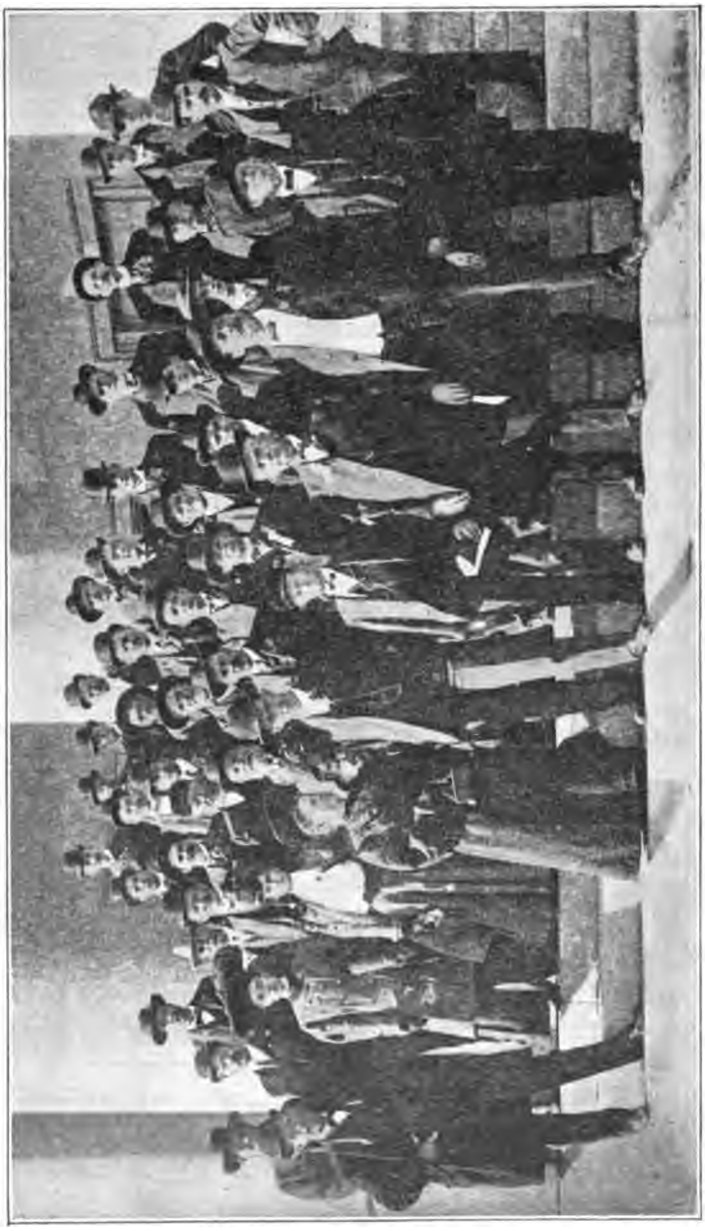
As soon as the proper amount of bisulphide of carbon has been placed on top of the corn or other grain or seed, the person should leave the bin at once, close the door and keep it closed for three days. It may then be opened and the fumes allowed to escape. It is well to thus fumigate corn soon after it is husked and put in the granary, and if it is badly infested it is a good plan to fumigate again in the spring.

This fumigation will kill not only the insects that may be within the room, but will also kill mice and rats confined in such places.

There is one precaution in the use of bisulphide of carbon which should not be overlooked. While bisulphide of carbon is perfectly harmless to handle, yet one should not use it near a lighted lantern or lighted pipe, or near any trace of fire whatever; neither should one enter the room, granary or bin while the fumes of this bisulphide of carbon are there with a lantern or a lighted pipe, because in so doing an explosion would be sure to follow. Do not let this precaution, however, prevent anyone from using this material, since it is one of the best substances that we know of for killing insects that are confined within a closed place. It is hardly necessary to caution a person about staying too long in a room where the fumes are very dense, because few people would stand the disagreeable odor of this substance long enough to be injured.

The bisulphide of carbon is a clear, heavy liquid that evaporates immediately, and will not injure the seed for germinating purposes nor for milling purposes when used as directed.

Bisulphide of carbon may be obtained from the manufacturers in fifty-pound cans, which are about the size of five-gallon cans, for ten cents per pound. It is, therefore, a comparatively cheap substance considering the amount of good one can will do.



A group of delegates attending the 16th annual meeting of Missouri State Dairy Association, Jefferson City, 1905.

Missouri State Dairy Association.

A condensed report of the proceedings of the Sixteenth Annual Meeting, held at Jefferson City, November 15, 16 and 17, 1905.

STATEMENT.

The 16th annual meeting of the Missouri State Dairy Association was held in the State Capitol, Jefferson City, November 15 to 17, 1905. A very interesting and instructive program was carried out during the three days of the meeting, but for lack of space only those papers giving the most practical information to the dairymen of the State can be published in this bulletin. The officers and members of the Association deserve great credit for their successsful efforts in developing the dairy business of Missouri.

Mention is made below of those persons who were on the program and contributed to the success of the meeting, but whose addresses are not printed in this bulletin:

Invocation, Rev. C. E. Patillo, Jefferson City.
Address of welcome, Hon. H. J. Wallau, Jefferson City.
Response, Secretary M. V. Carroll, Sedalia.
President's annual address, Hon. W. W. Marple, St. Joseph.
"Dairying in England," Hon. R. H. Pethebridge, St. Louis.
"The American Queen," Mrs. Nellie Kedzie Jones, Kalamazoo, Michigan.
"Dairy Industry in Illinois," Hon. Alfred H. Jones, Robinson, Ill.
"How to Improve the Dairy Cow," Hon. A. J. Glover, Ft. Atkinson, Wis.
"County Road Administration," Hon. A. M. Johnson, Washington, D. C.
"Dairying in the Wilderness," Mr. J. H. Curran, St. Louis.
"Relation of Railroads to the Dairy Industry," Mr. S. R. Young, St. Louis.
"Development of the Dairy Industry in Missouri," Mr. Geo. B. Ellis, Columbia.
"What We Are Doing in Minnesota," Hon. Edw. K. Slater, St. Paul, Minn.
"Dairying in Iowa," Hon. S. B. Shilling, Des Moines, Iowa.
"Dairying in the Southwest," Mr. F. S. White, Springfield.
"Social Phases of Dairying," Hon. D. P. Ashburn, Gibbon, Neb.

THE SILO AS A FACTOR IN ECONOMICAL FEEDING.

(By Hon. John Patterson, Kirksville, Mo.)

The economy in feeding cows is not saving feed, for the more you can get her to eat and digest, the more she will make for her keeper. When I think of that I remember what the Swedish dairyman said: "If I feed a half gallon of barley a day, I get nothing for it; she needs that for her own support. But if I feed a whole gallon, she gives enough more to pay double for it." That means if you feed little, you lose the value of that, but if you feed generously she makes you a profit. That is, she ought to have all she can eat and digest properly. Besides feed, she must be kept in a comfortable place so as not to be exposed to storms, rain and snow; she must be handled by folks that know how to be good to a cow. There are some men that it is not possible to learn that. They will roar, swear and beat her for awkwardness and roughness of their own, where a man that would be gentle and kind would have no trouble.

The first thing is the procuring of feed. I take it that the dairyman is a farmer and runs his farm to produce dairy products. Then he wants to raise as nearly as possible all the feed on the farm. He has it before him to consider what to raise that will make most, best and cheapest feed. I think I have studied all parts of the known world for all the different plants to find something good and very productive. I have tried nearly all the new things, such as Pencelaria, sunflower, vetches, sugar cane, cow peas and clovers, and, of course, our greatest of all feeds, the common corn. I say *greatest* because I think it is best and yields more per acre. But the common way of letting it get dry and hard, then gathering only the ears, grinding or feeding whole, is not the best. When I first begun dairying I would cut and shuck it, run it through a cutting machine that mixed the corn with the fodder and two to four pounds of bran. I thought I did as well as I could to get the most benefit of the corn, but that left a great deal of corn stalks they would not eat with sufficient amount of clover hay that was fairly good.

Next I raised cow peas and built silos, cut the corn when it was somewhat green and the corn a little too hard for roasting ears. I mixed corn and cow peas, one load of peas to two of corn. That makes an ensilage that cows will eat better than corn alone. But the ground I had in peas did not produce more than one-third as much feed as good corn. So I think corn pays best because you get the most, and with good clover hay and plenty of ensilage, you get something near a good ration. But for full flow of milk it needs something of what corn lacks mixed with ensilage. This time oats was a good crop and cheaper than bran. A few pounds, say three to six pounds, mixed in the ensilage, seems to give good results. Don't need to grind oats when mixing with ensilage, as the cow will grind it good when mixed with something she has to chew.

When I speak of the economy of putting corn in silos to feed cows, I don't mean it is good for cows only—it is good for all kinds of stock. All seem to like it and thrive on it, and when you get building and machinery for it, it don't cost any more to put it in silos than to cut and shock, etc., and it is much more convenient to feed in barns or sheds, where stock can be kept comfortable and all the manure can be saved. That subject will need more and more to be considered. Our lands are showing the need of it, and when applied they make great increase in production. I think it belongs to good farming to make and apply fertilizers as well as to cultivate good.

ENSILAGE YIELDS RICH FERTILIZER.

There is a subject in this that I have never heard mentioned: that any plant cut at the best time for making good feed is also the best time to make good fertilizer, and that corn stalks left standing until they are dead and weather-beaten have nearly no fertilizing quality in them, and other vegetation the same way. I can not tell where it goes to, only I don't think they are any benefit to land. That makes me think corn put in silos makes more valuable fertilizer than dried stuff and frosted and weather-beaten vegetation. I think silos are sure to come into general use, although the farmers who only aim to raise beef are very slow to turn to it. It seems too costly to build silos and buy cutting machines, etc., but that will be changed. I look for this way of making artificial rock out of sand and gravel, and cement will be the material for building. Such will be air and water tight, and that is the essential in a silo. The machinery will soon be gotten by those who run threshing outfits. The machine is on wheels and can be folded and set up and taken down quicker than a threshing machine.

Some experiment station published finding 45 per cent of the food value of the corn was in the stalk, leaves, husk and tassel. That is nearly as much as the corn, and when put in silos at the right time it will all be eaten and be good food, and I don't know any way to handle corn so it will be eaten so well. So I think it good policy to work the corn crop into the silo, and they that don't do that allow themselves to suffer big loss that could well be prevented.

NECESSITY FOR GOOD COWS.

I can hardly stop till I say something about the necessity of good cows, as almost all farmers will fool away valuable time and feed with what they call "all-purpose" cows, thinking they must have a sort that will bring a steer calf that the feeder and butcher will have. Try to get cows that will produce good quality and quantity of milk. Never mind the steer calves if you aim to make on dairy products. If you feed them well you can make them good to butcher when a month to twelve months old, even if he is a Jersey steer, and the heifers should be raised for cows. If you get heifer calves from unprofitable cows, use them the same as the steer calves.

LESSONS FROM EUROPEAN DAIRYING.

(Prof. O. H. Eckles, Chief of Dairy Division, Missouri Agricultural College.)

The American dairyman who studies dairy methods in Europe finds much to criticise, but learns many lessons that will never be forgotten. After such a study, one can see the strong and weak points of our dairy methods far more clearly, and can estimate fairly accurately our present state of advancement. We are not interested in a discussion of what the European can learn from us, but rather what we can learn from him.

My impressions of European dairying, after a year's study, are more general than particular. I have seen many dairy machines new to me; many breeds of cattle I never saw before; new styles of farm and dairy construction, and new ways of doing things, but I can enumerate very few particular things that I shall attempt to introduce into our dairy practice.

My general impressions are very strong. First of all, I have a deeper faith in dairy farming than ever before. I appreciate now as never before that the dairy cow is absolutely necessary for the highest development of our Agriculture. The most highly developed agricultural regions in Europe are the noted dairy countries. The most intelligent and most prosperous European farmers are dairy farmers. The richest land and the highest priced fairly swarms with dairy cows. The multitudes of farms there, that are more fertile today than fifty years ago, have been made so by dairy farming.

I was strongly impressed with the same fact, which so many Missouri farmers have recently found out, that the cow, and not the steer, is the animal for high-priced lands.

In Denmark, Sweden and Germany I saw land, mostly rather inferior by nature, but worth from $300 per acre upwards; in Holland, land worth from $800 to $2,000 per acre; in the Island of Jersey, $1,200 to $2,500 per acre, with an average yearly rental of about $50 per acre.

In these countries the fattening steer is unknown, but cows are everywhere. The cow is a cheaper producer of human food than the steer, and must increase as our lands become dearer.

Again, the wonderful effect of dairying as a means of keeping up the fertility of the soil is seen to good advantage in Europe. In the dairy countries the land grows better crops than it did twenty-five or fifty years ago. Denmark is the best example of this. Thirty years ago agriculture was at a low ebb there, and the people were coming to America in swarms. Now, after their dairy industry has been built up, very few are leaving home, and the Danish farmers appear to be the most intelligent and most prosperous in Europe, and their lands are richer today than ever before. The same is true regarding the increase in fertility of Germany, Switzerland, the Channel Islands, and the dairy parts of England.

It is in America, with some of the richest land in the world, where we hear the most about exhausted soils and decreasing fertility.

Preservation of Manure.—Maintaining the fertility of the land requires the saving and application of the manure to the land. In Europe this is done much better, as a rule, than here. On the majority of farms there is a careful provision for the preservation of the manure. It is not thrown out under the eaves of the barn to be leached all summer by rain. Generally a cemented pit of some kind, often covered with a roof, is provided to hold the manure. The liquid, as well as the solid, is saved and applied to the land. In Switzerland manure is often carried some distance up the side of the mountains in a box strapped to the back. The Jersey Island farmer, paying $50 to $60 per acre annual rental, uses about 20 loads of stable manure per acre annually, or about 90 loads of seaweed.

Intensive Cultivation.—The European farmer farms less land than we do. He does not attempt to spread over all the land in sight, but makes a comfortable living on a piece of land a Missouri farmer would not think large enough to raise a pair of mules. He does not have any fence corners to grow up to weeds, or plow around a small patch of brush. Every foot of land is utilized. Where the land is so rocky or so steep it cannot be cultivated, it is carefully planted to forest trees. I fully believe there are more weeds grown annually in one county in this or adjoining states than grow in the entire German empire.

Economical Production.—The farmers of Europe must constantly guard the cost of production. Their land is very expensive, feeds are much higher than here, and the selling price for dairy products. but slightly higher than here. In a German town of 30,000 population the highest retail price of butter last winter was 37c per pound, while in Columbia butter sold at 35c. I visited several German farmers producing the milk from which this butter was produced. It was produced on land worth nearly $1,000 per acre. The grain fed included considerable cottonseed meal brought from the United States. Their labor bill was, of course, less than ours. Milk sells at retail in the cities at about the same as it does here. Under these conditions it is evident the farmer must produce milk economically, or he could not live. He does this by economical feeding and by selecting the proper individual cow more carefully than the average American dairyman.

The spirit of carefulness and saving of little things is very noticeable in the methods of feeding. I think, as a rule, their feeding methods are rather more rational than ours. Cottonseed and linseed meals seem to be appreciated rather more abroad than at home, and are fed far more generally. For hay, clover and alfalfa are mostly grown wherever it can be on the Continent, and the importance of this class of feeds is fully appreciated. On almost every farm of any size there is a foreman who understands correct feeding, and he decides the amount and kind of feed to be used. This foreman, as a rule, has taken a course at some agricultural school.

Test Associations.—Of equal importance with the feed is the individuality of the cow as a factor affecting the cost of production. We are now in the midst of a great agitation in America over the necessity of better selection of dairy cows. This is one of the weakest points in our dairy operations, and to better it we should consider the advisability of establishing here what are known in Denmark as Test Associations. Ten years ago the first Test Association was organized in Denmark. Today there are over 300, and the system has spread with amazing rapidity for conservative Europe. They are now also found in Sweden, Norway, Germany and Holland, and are spreading rapidly, due to constant agitation of the matter in the agricultural papers.

Farmers owning about 1,000 cows form a co-operative association. They hire a man, usually a student from an agricultural school, as tester. This man visits each farm about once every three weeks. He weighs the milk from each cow and tests it for butter fat. He also weighs the feed given the cow. A record is then kept, showing the milk and butter produced by each cow and the cost of the feed. At the end of the year the farmer knows just what profit each cow has made, and the unprofitable ones are disposed of as soon as possible. Heifer calves are raised from the best only. As a result, the average production of milk by this breed has increased surprisingly within a few years, and probably the breed is being improved faster than any other breed in the world.

We need some such systematic method of testing our cows, and I believe we need it more than any other one thing. A farmer can buy a Babcock tester and test his own cows, but he rarely does it, and when he does it is usually done in anything but a systematic way, and only a little of the possible benefits is derived.

Agricultural Schools.—Another lesson from European agriculture is the benefit derived from agricultural schools. While they have nothing to compare in equipment with our leading agricultural colleges, they have vastly more schools for teaching agriculture. These are mostly purely practical schools, and rank about with the short courses given in our agricultural colleges.

Denmark, with an area of one-fourth that of Missouri, has forty-four well-attended agricultural schools. To compare with Denmark, according to area, Missouri would have to have one hundred and seventy-six agricultural schools.

Dairy Management in Holland.—No dairyman can visit Holland without being a cleaner and a better dairyman. Outside Holland, the European dairymen, in my opinion, are behind us in regard to cleanliness, but we are not in the same class with Holland. It has been well said that this remarkable country is a cow's paradise. Here she certainly receives the best treatment of any place in the world. The farm buildings are all of brick and of a uniform style. A common door leads directly from the kitchen into the cow stable. Here the cows remain constantly about seven months in the year, and are cared for most carefully. They stand very close to the family in the affections of the owner. In summer they are on pasture constantly, and if a cold wind or rain comes they are blanketed in the pastures. At short intervals they are taken to the canals and washed.

Behind each stall in the barn hangs a string from the ceiling, which is tied to the bush of the tail, so when she lies down it is not soiled. The Holland cows, called Holsteins in America, although they do not come from Holstein, are a beautiful lot, and respond to the unusual care with immense yields of milk. Holland dairying teaches us that careful, kind treatment and comfortable surroundings pay handsomely when given to a dairy cow.

Lessons for the Buttermakers.—The factory operator sees many things of interest in Europe. In dairy machinery I consider we are in the lead, except in regard to pasteurizers. The Danish pasteurizer I like better than any used in the United States. One is also strongly impressed there with the advantages of pasteurization. In Denmark and North Germany it is practically universal for buttermaking. The use of the pure culture is general in the same regions. Pasteurization and pure culture starters, the good milk supply, traveling inspectors and frequent scorings of butter are the factors that make Danish butter of such a high and uniform grade that it has captured the English market. The Danish buttermaker works under very favorable conditions. His milk all comes from within a short distance, and is separated at the factory, and most farmers have enough so it is well cared for. Who could not make good butter from such milk, with pasteurization and pure culture starters? I am sure the American buttermakers could do equally well under similar conditions, and I believe they are doing so now in certain localities where the milk supply is large.

Another impression is the difference in the creamery buildings put up here and abroad. There, even the smaller are of brick, and have a brick chimney. They look permanent in contrast to our wooden buildings, which look more like they were built as an experiment.

Co-operation.—An entire evening might be spent in considering the remarkable features of co-operation as found among Danish farmers. Co-operative factories make almost all the butter, and have a central committee that sells it in England without middlemen. Other societies gather and market eggs, buy fertilizers, feeds and seeds, and in fact, all the farmer needs. He escapes the meat trust by selling his hogs to the co-operative bacon factories or slaughter houses, of which there are thirty in Denmark. Similar organizations own most of the improved breeding animals, and, as already mentioned, test the cows. In fact, most of the business, both buying and selling, is done by co-operation.

In closing, it may be noticed they are largely the same old lessons which we learned, or should have learned, long ago. Retaining the fertility of the land by keeping the dairy cow; keeping down the cost of production by careful, intelligent feeding and constant selection of the individual cow; maintaining the production of milk to a high level by careful, kindly treatment and comfortable surroundings; universal use of pasteurization and pure cultures in factories; making of more and better cheese. These are the strongest lessons learned by the writer, who will teach and practice them more earnestly than ever before.

THE PROBLEM OF DAIRY CATTLE IMPROVEMENT.

(By Hon. A. S. Ennis, California, Mo.)

There is no subject that can come before this Association of more importance to the people here assembled than the subject of this paper. In spite of the hundreds of splendid cows in this State, the average milk production is stated to be considerably less than 3,000 pounds, and butter less than 150 pounds per year per cow. It follows that the owners of these average cows, and many of the cows above the average, and *all* of the cows below the average, *must* be interested in the improvement of their dairy cattle. Their future prosperity in the dairy business will be measured more by the extent of the improvement of their cows than by any other one thing, if not all other things.

Several years ago the writer visited one of the dairies adjacent to Jefferson City, and was told before going that this particular dairy ranked as one of the best here. I found cows in very good condition and very well fed—not very well stabled. Amongst many questions I asked was, if his herd would average a gallon a day the year round. His reply was: "It takes a mighty good cow to average a gallon of milk a day the year round." Now, my friends, a *"mighty good"* cow ought to average three gallons of milk per day for the year (if a Jersey) and more if a Holstein or Ayrshire. In improving a herd of grade Jerseys I would set the mark at two gallons per day of 5 per cent milk, and if some other breed, then let them produce the equivalent to this. You can reach this mark, and it can then be set higher.

SIX REQUISITES FOR SUCCESS.

There are six things that I wish to briefly mention in the discussion of this subject, viz.: *Know* what your cows are doing; dispose of your unprofitable cows; select a proper sire for your coming herd; (this is the most important of all). Then, your feed, your stable and proper treatment of your cows.

First—*Know* what your cows are doing. In other words, weigh and test your milk. If you can not weigh each milking and test each cow once a week, as the most of you can not at the present time, then try to weigh the milk and make a test on the 10th, 20th and 30th of each month, weighing and testing each cow's milk separately, and mark it down on a ruled sheet of paper, using a separate sheet for each cow. This is not nearly as big a job as you will imagine it to be, and if you make these tests on regular days three times a month, you will have for your own information just about as complete a record of each cow's year's work as though you weighed each day's milk, and you will have only one-tenth of the work. However, it isn't much trouble to weigh each milking, if you have scales in the barn for that purpose and a sheet of paper fastened to a card board, properly ruled, behind each cow's stall. But if you just won't do either of these things, then at the very least weigh *the total milk from your whole herd once every ten days* (or on the 10th, 20th and 30th of each month) and test it if you can, but weigh it anyhow. You will then know what your herd has done for the year, but it will be next to impossible for you to pick out the profitable and unprofitable cows. That is the great advantage of weighing the milk of each cow separately. The extra time you take for this work will be more than paid for by the increased production of your cows, for you will take special interest in just what each individual is doing, and without knowing it you will give your herd better care and attention, and get better yield of milk on account of it. Then, also, you can weed out unprofitable cows, and show a saving in this way the following year.

SELL THE "BOARDERS."

This blends into the second step: Dispose of your unprofitable cows. With a very little figuring you can tell about what your cows are costing you, and you can also figure without trouble what you are getting per gallon for your milk. When you find that a cow is actually losing you money, sell her—not to your neighbor, however, unless he happens to be a butcher. A neighbor of mine sold me this sort of a cow, but he left the country right away. Two years later this cow was done up in nice tin can packages and sold for choice meat, with apologies and regret for its not being done a few years sooner. There is no use in trying to breed up absolutely unprofitable cows, but keep your cows that are showing you a reasonable profit and you can soon build up a much more profitable herd.

These are really the first two big steps toward dairy cattle improvement, but the most of you will take, or have taken, the third step before the first two—that is

SELECT A PROPER SIRE.

If you have already taken this step, then take the other two just mentioned just as soon as you can. The bull is said to be "half of the herd," but in a herd of poor grades or native cows he is very much more than half. All of you can afford a good bull, even if you have to buy him when a calf and await his development. By all means buy a *registered* bull, but don't buy him just because he *is registered.* There are a lot of them registered that you have no business with, and that ought not to be registered. Get the pedigree of the bull you contemplate buying, find out what his sire was and the dam of his sire, and be still more particular to find out just what kind of a cow his own dam is. Go slow on this subject and buy the very best dairy-bred bull you can. Pay not so much attention to his ancestors' prize winnings at the fairs, as to what they can do at the pail and churn. Look for steady records all the way back in the pedigree, and do not seek for one or two sensational records; do not put too much stress on noted animals far back in the pedigree, but look more to those closer up. Try to be sure you are buying from a reputable breeder; get quotations from several of this class and compare them; then when you have selected two or three bulls that you think will just suit you, write the owner of each, and get from him (if he has not already sent you) full information regarding the sire and dam, grand sire. and grand dam of the bull you think of buying—don't be afraid to ask him any question you want to know. Remember that it means a lot to you not to make a mistake right here. After you have bought your bull and got him home, give him the best place to stay that you can, and a small pasture to run in, if possible, but do not let him run with your cows. Always lead him with a staff, be kind with him, and you will not likely have a vicious bull to deal with. Only allow one service when your cow is in heat. It is enough, and saves your bull. Keep this bull until a number of his calves have milked a good part of the first year—and keep all of his first heifer calves that you can out of your best cows. If the heifers show good improvement over their dams you can feel that you are on the right track, and then you will want another bull to cross onto your heifers. My advice is to get a bull out of the same dam as your old bull, or out of her best daughters, and sired by a bull that has been bred to them with success before. You will find that your bull has nicked better with some of your cows than with others. Always keep the best heifers and calves from them. You will now gradually be selling off your old cows and keeping your improved heifers. About the second cross you make you will find some of the heifers giving more milk and making more butter with their first calves than their grandmothers ever made for you in the prime of their lives. Then you will begin to realize what this improvement really means. Refer once more to the dairy I spoke of having visited. Some of the cows in this herd could have been bred to a proper sire, and in three generations a cow could have been produced that would have given nearly twice the quantity of milk, and the actual cost of feed would not have been more, but most likely would be less.

THE SPECIAL PURPOSE COW.

But let me say right here that I am a firm believer in the special purpose cow. I would no more think of breeding beef cattle for the dairy than I would think of putting a fine Belgian draft stallion on the track in an endeavor to beat the time record of Dan Patch. You want a cow for the dairy that will convert your feed into milk and butter, and that will not get over fat just because you feed her well. If you are in the dairy business you can't afford to raise calves to sell at beef prices. Stick to one of the pronounced dairy breeds or one of the pronounced beef breeds, and produce milk and butter or meat and hides. You are not rich enough to mix together these widely different types, pull out a few lottery tickets in the shape of heifers, and wait two or three years to see whether you got one of the few prizes or not.

Now, a word about feed. This is a subject you will have to give special and careful attention. You must not only look to the needs of your cattle, but you must endeavor to get their ration as nearly as possible from products of your own farm. Economy is one of your watch words. I strongly recommend to you all the address of Mr. Patterson on this subject. But you must make it a study, and it will take you several years. Look first to the needs of your cows, and next to the cost of the feed. Your heifer calves should be fed sweet skim milk for about six months, and can have mixed with it a little corn meal and oil meal—or these can be fed separately. After six months, if on good pasture, they will require no feed, but as fall comes on they should not be allowed to run down and get poor before winter feeding is begun. This should consist of bran, shorts, oil meal, etc., with fodder, hay and straw for roughage. I would feed no corn. A few weeks before your heifer is due with her first calf you should begin feeding her a mixture of food rich in protein. Do not overfeed her, but gradually increase the feed until by the time she drops her calf she will be getting about all she wants to eat. You will find she has made a very large udder and will start off with a large flow of milk.

For a few days after calving feed lightly, gradually increasing, and you will find her responding well to your attention. Keep her in milk for ten or twelve months. There is no danger from milk fever with the first calf, but from then on, and especially with the third and fourth calves, you cannot feed so heavily before calving, but neither will she require it, for by then the habit of milk giving has been well formed.

Always have a good warm stable, well ventilated; keep it clean and the cows well bedded. Always keep the same cow in the same stall; the same milker milking the same cow, and the cows milked and fed regularly and in the same order each time.

KIND TREATMENT A POTENT FACTOR.

Buy the best cow you can and give her all the feed in the land and a warm stable, but yell at her, beat and abuse her, and you will get but little milk from her. There is no more essential thing connected with successful dairying than kind and gentle treatment of the cows. You have not reached the proper point in this respect until you can walk through your herd in the lot, swinging a stick and not a cow get out of your way. This is not dreaming, but is an accomplished fact at my place, and I can tell you that we are well paid for it, too, and any of you can do the same.

I have briefly touched the six key-notes, which, if you will study and make a part of your business, are sure to bring you success. But I would not have you believe that when you follow these suggestions your success will be without a set-back. You are going to meet with disappointments; some of your favorite cows are likely to be found unprofitable; some of them are sure to drop heifers that, after much care and attention, will disappoint you; some of your breeding crosses will not prove a success. But all of these will only make you the keener in your business, and will only make your ultimate success that much more satisfactory to you. To me (and I think you will find it so to you) the breeding part of the dairy business is the most interesting. Yet we have a class of dairymen (none of whom are likely in this assembly) whose only policy is to buy, milk and then kill. Had I the time I would like to pay my respects to this class of dairymen, but will only take time to say that I have no use for such a policy, even though it may make more cold, hard cash, but this policy also does its utmost to destroy the dairy industry, and if followed to any great extent generally it would destroy it. By all means raise your best calves; you will find you can raise much better cows than you can buy, and you will also be doing good to the whole community.

Before closing this paper I want to give you one example of breeding, and you will pardon me for taking it from my own herd, but it illustrates a point which I wish to bring out. When I was about twelve years old I began breeding grade Jerseys, the first cow bought being represented as a seven-eighths Jersey, and I then had access to a first-class Jersey sire. For some years my breeding of this family was quite successful, and when I grew older I began selecting the sire more carefully. But upon one occasion a descendant of this old cow was taken from my herd and crossed with a Jersey bull that was supposed to be a fine one; the result of the cross was a heifer calf, and is now a six-year old cow, so far inferior to her dam in every respect that she would never be recognized. She simply looks what she is—reverted many generations to some back ancestors. And yet she is not entirely unprofitable. I have several times crossed this cow with my own bulls, and her oldest calf has gone right back to the old type and is the very best grade cow in my herd; her next oldest calf is just coming into milk and promises as well as the other. This inferior cow's dam also has a heifer just coming in milk, and the two heifers can hardly be distinguished. I mention this simply to warn you of the dangers of promiscuous breeding, or crossing of different breeds. Stick to a line of breeding, and although you need not closely in-breed, yet when you introduce an out-cross, do so very carefully. Often when breeds are crossed the first cross is an improvement, but in such cases the second cross is nearly always a hard-looking specimen.

I would suggest further that if any of you are in doubt as to proper steps to take in any matter of dairying, that you write your Agricultural College, some good, reliable dairy paper, and any responsible and successful dairyman whom you think could help you out. Just enclose a stamp or stamped envelope and you will surely get replies and suggestions from all. Now, some of these may not exactly agree with others, but they will all be helpful to you and you can use your own judgment as your special case seems to require. I know had I followed this policy more than I have it would have been better for me, and you will all find the same to be the case with you I am quite sure. Do not be backward about writing your troubles to private individuals—it is true many are quite busy and you must not always expect long replies, but I take it that any honest dairyman, with dairy interests properly at heart, will consider it a pleasure to send you, may be just a few lines, but enough to put you on the right track if you have made or are about to make a mistake.

MISSOURI'S FUTURE IN DAIRYING.

Now, just a word in conclusion. Missouri is rapidly developing the dairy industry, and beyond doubt is destined to be one of the greatest, if not the greatest, dairying State in the Union. I expect to live to see her lead all other states in this industry. Three or four years ago I seldom noticed the transfer of a registered dairy animal to a party in Missouri, and now I venture to say not a week passes but that a dozen or more registered dairy cattle are purchased by Missourians. For the last week in October there were nearly a dozen transfers recorded of Jerseys alone, and I am sorry I am not in possession of this information as to other dairy breeds also.

Very few of the old time native cattle can now be found—nearly everything is either good grades of beef, or fair grades of dairy animals. Yet we are not nearly where we should be. But no other state is having such an awakening of interest in dairying, and as our dairy cattle are improved in quality as also in numbers our state will gradually and rapidly rank higher and higher until she stands at the top, where she so justly will belong, and she may then well erect a monument of a magnificient dairy bull to commemorate the prosperity and happiness his introduction brought to her citizens. We will then gaze upon the dairy bull as he proudly and impatiently walks up and down the fence of his paddock, and we will say: "To you, Mr. Dairy Bull, do we owe this great honor, our good homes, our valuable land, our profitable business. You took us when we were poor and made us well-to-do. In our adversity you came to our help and in our prosperity you cling to us."

NEEDED LEGISLATION.

(By Hon. R. M. Washburn, State Dairy Commissioner of Missouri.)

You all know what happened last winter. The dairymen united; they wanted something and they got it, and it is time now for the dairymen of this State to unite again and make further demands. As I go over the State talking at farmers' institute meetings, and especially at dairy meetings, where the farmers have been educated in daily work until they know how to feed, know the value of concentrated feeds, and are continually buying feeds containing protein; where the men have already been educated past the point of *why* they should dairy and are studying the economy side of dairying; in those sections there is quite a strong demand for some control by the State over the *quality* of the feeds they buy. It is really not an uncommon thing to go into a community and have farmers complain that the purchased foods give them very poor results. They do not get from that feed the results they have a right to expect. They buy feed for $25 or $30 a ton and find that it does not do the business that it should. They have had it analyzed. The chemist in the Agricultural College told me that it was not at all uncommon for this analysis to show bran testing as low as six per cent protein instead of 15 or 16, as it should test; and that cotton seed meal, in which there was mixed ground hulls and other refuse of that nature, instead of testing 40 per cent to 42 per cent, the protein contents go down to 37 per cent or even lower.

It is time that the dairymen of this State, through the Dairymen's Association, demanded a feed inspection.

This is not a new branch in State work. A great many of the eastern states now have inspectors of stock feeds. Practically all of the New England states send out inspectors each spring and fall, who take samples of feed here and there. Every sack of feed put on the market by any firm must have on it a tag giving the analysis of that feed. If the feed does not analyze up to the guarantee, that firm is liable to prosecution. I really do not believe that that would work a hardship on many. I honestly have enough faith in humanity to feel that the majority of men selling these feeds have been forced to adulterate their goods in order to meet the prices of those who adulterated first; for when one man adds ground cob and oat hulls to his bran and sells his goods cheaper than the other fellow, the other fellow, in order to sell his goods, has to bring them down to the same price, which can be done ouly by adulteration. There is already in the State a fertilizer control under the management of the Agricultural Experiment Station. This institution sends out each spring and fall an inspector who gathers samples of fertilizers; these are analyzed at the Experiment Station, and the result is that when you buy any fertilizer on the market it contains the ingredients—nitrogen, phosphoric acid and potash in the proportion named on the tags giving the analysis.

Now, whether this inspection of feeds be placed in the hands of the State Dairy Commissioner or the Agricultural College, it makes no difference, just so we get the work done; but it is time, as soon as the Legislature meets again, that we, as dairymen, through the Association, demand action on that point.

There are other adulterations, which would hardly come under that of grain feed. There is a new feed on the market—alfalfa meal—which is an especially fine feed when it is pure, but which, being ground fine, has the disadvantage of easy adulteration, and samples have been analyzed in this State which, instead of being pure alfalfa leaves and stems ground up with a protein content of 16.50 per cent, contained other feed, such as timothy or prairie hay, which reduced the protein content to 12.50 per cent, and which was not recognizable because of the very fine condition of the meal. I would suggest to those buying feeds which have been ground to such a fine state that the original kernel or stalk in that feed is not recognizable, that they have it analyzed. So soon as the identity of the grain or stalk is destroyed, adulteration becomes easy. I was authorized yesterday by the State Chemist at Columbia to say that if you are going to buy any feed in carload lots (would not bother about analyzing a few sacks) at high prices, you first get a guarantee from the concern from whom you buy of the analysis of that feed; then get three reliable citizens to see you take a sample from those sacks, do it up, and mail it to the Experiment Station at Columbia and they will analyze it free. Now, of course, even if you do find they have cheated you in representing a high per cent of protein, when there is but a low per cent, you cannot prosecute because there is no law on the subject, but you can publish them, and frequently publicity is a sufficient weapon to use. You understand we need to have the support of every man in the State who cares at all for straight business.

There is another matter that demands attention. I want to call your attention to the awful bigness of Missouri—the great empire of Missouri; for two men to cover this State and do the things that the bill passed last year commanded the State Dairy Commissioner and his deputy to do, they have to spread themselves out over the State until they are awfully thin. The bill commands the State Dairy Commissioner to co-operate with the State Board of Agriculture in holding farmers' institute meetings throughout the State. I have been doing this. I have attended nearly 100 meetings since the first of August and will continue to do so until New Year's. Another division of the work assigned the State Dairy Commissioner besides working among the farmers, encouraging and instructing them, is the working with the butter makers and cheese makers of the State, aiding them to produce a better grade of butter and cheese, so that their goods will bring a higher price in the market. Then there is the most disagreeable part of the whole work, *i. e.* the inspection—the hunting and nosing around for adulterated goods. Considerable dairy butter in this State is worked over into ladles, so-called "ladle butter," and *borax* is added in order to preserve it. Milk containing formaldehyde is sold in all the large cities of the State and other milk is skimmed or watered. In order to accomplish what we would like to accomplish and what you want us to accomplish, we should have several more inspectors and a provision for paying them and their expenses. I think that this will put you in touch with the duties and troubles, you might say, of those who have the work immediately in hand, and I trust that when the Legislature meets again we may hear from you all in a definite manner.

GUARDING AGAINST THE INTRODUCTION OF TUBERCULOSIS INTO THE DAIRY HERDS OF MISSOURI.

(By Dr. D. F. Luckey, State Veterinarian of Missouri.)

In view of the fact that very little is heard of tuberculosis among the cattle in Missouri at the present time, and very little really exists among them, it can reasonably be asked why we should do anything to guard against its spread. The answer, if given in short, would be a very simple one. We simply want to prevent tuberculosis from ever becoming prevalent among our herds. Then are our herds in any immediate danger of becoming diseased with tuberculosis? The answer to this is positively in the affirmative. There is no accurate way of estimating the amount of tuberculosis among the cattle of any of the states of this country. We have sufficient information, however, to make reasonably accurate conclusions, and we know positively that in older states in particular tuberculosis has become very prevalent among cattle. The disease is spread from cattle to hogs, and the great number of hogs that are being condemned at the slaughtering centers on account of tuberculosis is causing considerable agitation among the packers. Their investigations show that the tuberculous hogs are coming principally from the older dairy districts, and they are, I am informed, seriously considering the question of buying hogs from such districts subject to post-mortem examination.

PREVALENCE IN OLDER STATES.

In many of the older states, notably Pennsylvania and Minnesota, where a very rigid campaign of testing the dairy herds has been carried on for years, so much tuberculosis is found among the cattle that its eradication seems almost a hopeless task. In England and European countries a closer investigation of the subject has been made and more accurate statistics may be obtained. It is found that on an average one out of every four of all classes of cattle in England are affected with tuberculosis. A prominent importer of Aberdeen Angus cattle from Scotland recently gave an interview in which he stated that an average of one out of five of the cattle which he selected to bring to this country proved on inspection to be affected with tuberculosis. In some of the European countries conditions are still worse. At certain slaughtering centers in Germany as many as 50 per cent, and in some cases as high as 75 per cent, of the carcasses of cattle slaughtered were condemned on account of tuberculosis. All investigations have shown that wherever cattle have been housed and exchanged from herd to herd for any length of time tuberculosis has become prevalent.

GENERAL SPREAD THREATENED.

For years past Missouri has been in the front ranks in breeding pure-bred beef cattle. Today the dairy industry is being developed with much rapidity, and a great number of people are going into the dairy business and founding dairy herds. Beef and dairy herds are being established and individuals being changed from herd to herd and the herds are being kept under the same identical conditions as have prevailed in the older states of this country, and in European countries where tuberculosis has become so prevalent among cattle as to amount to a scourge. Unless the breeders of cattle take some precaution, which has not heretofore been employed, there is but one inevitable result, and that is the general spread of tuberculosis among our cattle. It is not a matter of prophecy to say that we need only to go on as others have done, and as we are doing today, for a few years, and we will get the same results that have been obtained in other states and older countries.

CHARACTERISTICS OF THE DISEASE.

In order that we may go about the control of tuberculosis in an intelligent manner it is necessary for us to thoroughly understand three important facts, namely: (1) Tuberculosis is contagious. (2) It is seldom, if ever hereditary. (3) The disease does not necessarily affect the lungs, but may affect any organ of the body. The general impression regarding tuberculosis is that it is a non-contagious disease—a sort of inescapable curse. In handling herds of cattle we have had experience with a number of herds where the introduction of one or more diseased animals spread tuberculosis rapidly in the herd. In one case in particular five tuberculous cows were introduced into a dairy, and in six months' time 51 others had contracted tuberculosis. This same thing happens wherever cattle with tuberculosis are introduced into a healthy herd, and I could give numerous instances and call the names of owners of cattle where this very thing has happened in this State. If the diseased animal had not been admitted into the herd the disease would not have been present.

ITS HEREDITY CONTROVERTED.

As to the heredity of tuberculosis, we can only say that "among the many investigations all over the world, including thousands of post-mortems, the records show only 70 calves that were diseased shortly after birth." (Laws.) In one herd which, on inspection, I found to be about one-half healthy and one-half diseased, I had occasion to go back a few months later and test the 13 calves from the diseased cows, all of which proved to be free from tuberculosis. In one herd a certain cow was in the last stages of tuberculosis and reacted to the tuberculin test, which I shall describe later, and was killed; on post-mortem examination showed extensive lesions of tuberculosis of the lungs, heart, costal pleura, diaphragm and throat. This cow was the dam of two heifers, one 6 and the other 18 months old, which, when carefully examined and tested, were found to be free from tuberculosis. I have had this experience over and over, and I positively conclude from my own experience, as well as the statement of all authorities on the subject of tuberculosis, that the disease is not hereditary.

As to the prevalent opinion that tuberculosis is strictly a disease of the lungs, I need only to say that in the post-mortems which I have helped to make, I have found the disease in different cases in the glands of the throat, glands between the lungs, the lungs, costal pleura, liver, intestines and hock joints, without any other organ being diseased. The intestines and pulmonary form of tuberculosis are probably the most common in cattle, but the disease may be found in any part of the body whatsoever.

DIAGNOSIS IS PUZZLING.

The symptoms caused by tuberculosis, as can well be inferred from the foregoing statement, are so different in different cases as to make the diagnosis of the diseases a veritable puzzle. If none of the vital organs are affected there may be no symptoms whatever, and the animal may be fat and healthy-looking and still be capable of spreading tuberculosis. In such cases there is no method aside from the tuberculin test by which the presence of the disease may be known. When the glands of the throat are affected with tuberculosis the symptoms resemble those produced by lumpjaw; when the lungs are affected the cough, and emaciation when it comes, resembles the cough caused by the infestation of the lungs with lung worms or some form of pneumonia; when the intestines are affected the symptoms are those of some forms of indigestion; and when the joints of the limbs are affected the lameness resembles that produced by rheumatism or injury, so that we see that even in cases where the tuberculosis is so far advanced as to produce visible symptoms it is still impossible to decide whether those symptoms are caused by tuberculosis or by some other disease. It is necessary for us to understand all of these things thoroughly in order to go about the control of the disease in an intelligent manner.

SUCCESS OF TUBERCULIN TEST.

Fortunately we have an almost unerring method by which we can detect the presence of tuberculosis in any animal whether or not the disease is sufficiently advanced for the symptoms to become apparent on an ordinary examination. This method is known as the tuberculin test, which I shall describe briefly. A serum, known as tuberculin, made from the culture of tubercle bacilli, is injected under the skin of the animal to be tested, whereupon it is rapidly absorbed and carried into the blood stream. If the animal injected is free from tuberculosis there is no result whatever, from the injection. If the animal is diseased with tuberculosis there will follow in from 9 to 16 hours after the injection a marked rise in the temperature. The rise in the temperature indicating tuberculosis should be the highest at about the 13th hour after the injection, and should amount to as much as 3 degrees and often the rise of 5 or 6 degrees. Such a rise following between the 9th and 16th hour after the injection of a cow with tuberculin indicates that the animal is affected with tuberculosis. The temperature of cattle is somewhat irregular, and may be quite different in different individuals, so it becomes necessary in making the test to take the temperature of the animals to be tested two or three times before the injection is made in order to be able to make a correct comparison with the temperatures after injection. The following brief table shows the various temperatures of two animals which I have tested:

Date of March 11, before injection. Temperature.			Date, March 12, 1905. Temperatures after injection.			
No.	3 p. m.	6 p. m.	7 a. m.	9 a. m.	11 a. m.	1 p. m.
148	101.8	101.6	101.0	101.0	101.2	101.8
245	101.4	101.0	103.0	106.0	105.6	105.2

Each cow was injected with 2cc. or 30 drops of tuberculin at 9 o'clock p. m. March 11, 1905.

ILLUSTRATIONS OF THE TEST.

This table shows the temperatures of animals taken twice before the injection and four times after beginning the 10th hour after the injection. The highest temperature of No. 148 before injection was 101.8, the highest temperature after the injection, 101.8, showing no reaction whatever, so the animal was marked healthy. The highest temperature of 245 before injection was 101.4 and after injection 106.

These two instances fairly illustrate the results of the test of any herd. Where there are no tuberculous animals in the herd, results similar to 148 are obtained, and the tuberculous animals in a herd are shown by the reactions similar to those of 245. The ordinary fever thermometer is used for taking the temperature of the cattle per rectum, and the tuberculin test on the whole is a very simple, inexpensive method of knowing with the greatest accuracy whether or not the cattle are affected with tuberculosis. It is with the use of this method and this alone that anyone can found a herd of beef or dairy cattle with any assurance of its being free from tuberculosis.

UNFOUNDED OBJECTIONS TO TUBERCULIN.

Certain objections have been urged against the tuberculin test. Some say it is harmful to cattle, that it will produce disease, that it will cause abortion and that it may be used dishonestly. As far as its producing any bad results, I will say that I have yet to see a single sign of any bad effects from the injection of tuberculin. I have injected a one-pound guinea pig with a full dose for a thousand-pound cow without producing any bad effects whatever. I can, if necessary, secure from each of those for whom I have tested cattle with tuberculin a statement that no harmful effects whatever were produced by the injection.

Some claim that the injection of tuberculin might produce tuberculosis. This claim has no ground whatever for belief. While it is true that tuberculin is a liquid culture in which the germs of human tuberculosis have been grown and have charged with their toxic product, it is also true that it has been pasteurized sufficiently to kill all germs of tuberculosis and then filtered through a porcelain filter. It contains no germs whatever, of any description, either dead or alive, and cannot possibly produce any disease. The claim that tuberculin injection may cause abortion is equally unfounded. It is possible that in some cases contagious abortion has been spread by using the theremometer in the vagina. Such results will be improbable if not impossible if the thermometer is inserted per rectum, and no such results need follow if the tuberculin test is properly and intelligently applied.

POSSIBILITY OF DISHONESTY.

It is also clamed that the tuberculin test may be dishonestly used. It must be admitted that it is possible to use the tuberculin test, or anything else that man uses, dishonestly. A breeder of registered cattle may furnish a false pedigree or a dairyman may put water in his milk. There is a certain amount of dishonesty in everything, but no more I dare say in the use of the tuberculin test than in other lines of work.

If a breeder would give a false certificate of the tuberculin test in order to sell a diseased animal, I am satisfied that he would be willing to furnish a false pedigree, so the question of dishonesty is in no manner a legitimate argument against the use of the tuberculin test.

DANGER OF GENERAL SPREAD FORESEEN.

Coming down to the most important part of the question, I wish to explain that the State Board of Agriculture, foreseeing the danger of the general spread of tuberculosis among the cattle of this State, has decided to do everything in its power to prevent it. The veterinary service of the State is offered free to the breeders of registered beef cattle and to the dairymen, regardless of the breed of cattle in making the tuberculin test and veterinary examination of their herds. Without any expense whatever to the owner, it is proposed, upon the request of the owners, to make the test of any permanent herd in the State. This test is the only safeguard against the introduction of tuberculosis in our herds, and the matter is left with the owners of cattle whether or not they will avail themselves of the opportunity to know exactly what they are doing. It is not intended to force the test upon anyone. I simply explain the tuberculin test to the dairymen and the offer the State Board of Agriculture has made and trust to the common sense and good intentions of those engaged in any line of the cattle business to protect themselves.

BETTER LEGISLATION NEEDED.

An important question in this connection is as to what disposition to make of the animals that are found to be diseased. Under the present law it is impossible for the owner of a diseased animal to get any remuneration from the State, and there is no very satisfactory way at present of disposing of the diseased cattle. The statutes of the State, which provide for the killing of horses affected with glanders and paying the owner something for them, could easily be amended by adding the word tuberculosis, so that cattle found to be diseased could be condemned and the owner granted indemnity according to the value for as much as $30. It may at some future time be necessary to have some legislation in regard to the tuberculin test. As far as I am concerned, these matters will be left entirely with the breeders of beef and dairy cattle, and I will give my support to the passage of only such laws as seem satisfactory to them. It will, therefore, be necessary for the cattlemen to study their part of this question and take an interest in formulating such legislation as they may need for their own protection.

DISCUSSION.

Mr. Glover—Not long since our paper got some statistics directly from the packing houses of Chicago, and they show that the greater number of swine they are receiving that have tuberculosis come from the dairy districts. Now that means something to you dairymen. We cannot ignore it. They begin to trace it right back to the dairyman's door, and in some cases they are beginning to discriminate between dairymen's hogs and hogs not raised upon skimmed milk. This trouble can be overcome by pasteurizing the milk. And I want to preach sunlight and pure air in our barns. Are not people cured of consumption by sleeping out of doors in the pure air? It is the same with the animal. A great many of our dairymen seem to think darkness is best for their cow and impure air. If we get the impure air out of our barns we will largely overcome this disease that seems to be creeping upon us.

Remember two things—Pasteurize your skim milk and light and ventilate your stables.

Dr. Luckey—Mr. Glover is correct, but he is attaching too much importance to pure air and light as far as tuberculosis is concerned. One of the most expensive barns I ever saw contained diseased cows. The disease is found also among the cattle on the range where there is plenty of pure air and light. It is contagious, just as smallpox or anything else is. It spreads regardless of air and light. And we must apply the tuberculin test.

Mr. Glover—I would not have it go down before this convention that I do not believe in the tuberculin test, because I do. We test our herd; but there are so many people who do not realize the great importance of sunlight and air, and I believe it ought to be emphasized. The doctors recommend that consumptives spend as much time as possible in the open air, because the air and sunlight destroys the germs of the disease. Some men are sitting before me right now who have been cured of consumption in that way. Sunlight is the foe of bacteria. Put an animal in a foul close stable, with no ventilation, no opportunity of changing air, and his susceptibility to the disease will be greatly increased. I don't take any exception to what the doctor has said, but I want to emphasize these things. He said that one of the most expensive barns he ever saw had tuberculous cows—and I want to say that one of the most expensive barns I ever saw did not have any light or ventilation.

Dr. Luckey—The barn I had reference to was well supplied with light and ventilation. These things are important, but you must not get the impression that these things are *all* that is necessary to prevent tuberculosis—that is absolutely wrong. You can put your cattle in the best barn in the United States—the most wholesome barn you can get—but if you put diseased cattle in with yours, you will have trouble, regardless of light and ventilation. We want to prevent the spread of tuberculosis, but we cannot do it with pure air and sunshine.

Mr. ———. Can I make the test myself on my own cows?

Dr. Luckey—I won't say that everyone can do it right, but so far as I am concerned, there is no objection to your doing it. Every dairyman should learn to test his own herd. The veterinarian or State veterinarian, or someone who thoroughly understands the work, can show the dairymen how to make the test, and then the dairymen can go to work and test their own herds after they thoroughly understand it. This test is one of the most useful things in connection with the dairy.

Dr. Connaway—The work which Dr. Luckey is doing to free the infected cattle herds of the State from tuberculosis, and to prevent the introduction of the disease into herds that are now free from it, should have the commendation and active support of every dairyman and cattle breeder in the State. He is not offering to you a new and untried experiment, but a plan which the dairymen of Denmark, Norway and Sweden have found to be the salvation of their herds. A few brief statistics will illustrate this: Previous to the discovery of tuberculin, and its use as a diagnostic agent, Prof. Bang of Copenhagen had attempted to free the dairy herds of Denmark from tuberculosis by separating all cattle, that showed any signs of this disease, from those that appeared to be healthy, and raising the calves of diseased cows on sterile milk. Progress by this plan, however, was discouragingly slow from the fact that a considerable number of the animals that were supposed to be healthy, were in fact badly diseased, although this could not be determined by the ordinary means of diagnosis then in use. However, by the aid of tuberculin as a diagnostic agent, the separation of the diseased from the healthy cattle was more perfect. He began the use of the tuberculin test in 1893, and within the two and one-half years following, tested over 53,000 head of cattle and found nearly 40 per cent affected with tuberculosis—an average of slightly more than 21,000 head per year were tested. Compare this with the tests made in the year 1902, the latest complete statistics I have at hand, and you will find in this year a little more than 23,000 head were tested, with only 10.8

per cent reacting. This marked reduction speaks well for the tuberculin test and the other measures mentioned.

In Norway, in 1895, two thousand herds were tested, containing 25,000 or more cattle, and 27 per cent of the herds and 8.3 per cent of the cattle were diseased. Seven years later over 22,000 cattle were tested and only 11.5 per cent of the herds and 3.5 per cent of the cattle reacted to the tuberculin test.

In Sweden, in 1897, 70 per cent of the herds that were tested were found to be diseased; and 32 per cent of the cattle reacted to the tuberculin test. Five years later there had been a reduction of 55 per cent of tuberculous herds and 4.8 per cent of tuberculous cattle in the herds tested, a total of 30,000 cattle being examined.

The somewhat isolated position of these countries, and the fact that they rear at home most of the dairy stock, instead of importing, are circumstances which have aided in securing the good results mentioned.

In contrast to the results mentioned, let us look at the condition in some parts of Germany. In that country tuberculin is not so generally used as in Denmark, and a large percentage of the dairymen purchase their cows instead of raising them. According to Prof. Klimmer of Dresden, from whose address most of the facts here given are taken, there is a gradual increase in tuberculosis in Saxony; from the year 1896 to 1903, an increase of 4½ per cent. He is convinced from his own observations that fully two-thirds of the cattle of Saxony are tuberculous. He reports 79 per cent of reacting cattle in eight herds aggregating 259 animals, and belonging to a progressive breeder, who had supplied his animals the best hygienic conditions, but had neglected the tuberculin test. On another farm he found 80 per cent of the three-year old cattle infected, and of those under three years old, 67 per cent. On this farm, too, an attempt to carry out what is called the "Ostertag method" of exterminating tuberculosis (from Prof. Ostertag, Berlin,) had been in operation for five years. This method permits, but does not require the tuberculin test; but relies upon the ordinary clinical methods of diagnosis, supplemented by microscopical examination of the milk. If these methods do not reveal the disease, the cow is not considered dangerous to neighboring cows, even though she should react to tuberculin. Thus it is seen that a diseased animal may be kept in service along with healthy ones unless there is ocular evidence that she is casting off tubercle germs from the lungs by coughing, or from a diseased udder through the milk. The case reported by Prof. Klimmer demonstrates the inefficiency of this method of eradicating tuberculosis. Prof. Klimmer estimates that the dairies of Saxony lose annually fully a quarter of a million dollars from tuberculosis.

It is not necessary for us to look solely to foreign experiences to teach us lessons in this matter of tuberculosis. The conditions in the older dairy districts of our own country—in Massachusetts, New York, Pennsylvania, Illinois and Wisconsin—are not as ideal as we could wish, as shown by official publications from these states. In this connection I wish to recommend to you as a supplement to Dr. Luckey's bulletin, a popular bulletin recently issued by Dr. Russell, Bacteriologist of the Dairy Department of the Wisconsin Experiment Station. A request for this bulletin by postal card is all it will cost. The lesson it teaches may be the means of saving your business from ruin.

I consider it fortunate that this matter of tuberculosis is being brought to the attention of the dairymen now while the dairy industry in this State is yet in its infancy. The great interest which has developed within the past few years is full of prophecy that dairying is to be one of the leading industries of the State. It is important, therefore, while we are yet young in this business, to study the experiences of the dairies of the old world, and those in the older sections of our own country, and to profit by their successes and failures. That tuberculosis is one of the great obstacles to success, the records abundantly show. The vital question, therefore, is shall we neglect the measures which the Board of Agriculture, through its veterinary service, offers us in the way of prevention and eradication of this disease? As surely as these measures are neglected, the appalling conditions which exist in the dairy herds of some parts of the old world are sure to be our punishment. I have already mentioned the fact that the dairymen of Saxony lose a fourth of a million dollars yearly on account of this disease. Shall the dairymen of Missouri give up their profits in so needless a manner? I am sure you will not, if you join hands heartily with the Board of Agriculture in this fight against tuberculosis in the dairy herds. Beginning now, the work will be comparatively easy.

I wish to say a few words in regard to a new method of combatting tuberculosis which is now being much advertised. I refer to the "Von Behring-Bovo Vaccine." This vaccine is a culture of weakened *living human-tubercle-bacilli;* put on the market in a powder form. The powder is thoroughly mixed with sterilized water, to which has been added about 1 per cent of salt, and injected into the jugular vein of the animal which it is intended to immunize. Three months later a second inoculation is made. It is claimed that the animal is then protected against tuberculosis. Calves three months old or younger are selected for inoculation.

In regard to this method, the opinion of some of the best veterinarians in Germany is that the method is yet too new to pronounce upon its success. That is, it has not had the experimental test of a sufficient number of years under varying conditions, and under competent observers, who are financially disinterested, to justify its being put on sale for general use as a means of combating tuberculosis in cattle. Whether these calves will resist the natural infection under all circumstances has not yet been proven. Moreover, since these animals have been inoculated with *living human-tubercle-bacilli,* the question naturally arises: Is this not a dangerous procedure for human health? When these supposedly immune calves grow into mature milk cows, may not some dormant tubercular focus become active, under the stress of heavy milk-production, and give rise to an infection of the udder and milk? The rendering the animal more resistant to tuberculosis does not necessarily mean that such an animal may not bear the germs of tuberculosis in the udder and spread them through the milk. In the disease we call Texas fever, we have an example of perfectly immune cattle carrying germs that are deadly to our northern raised cattle. For my part, I prefer my milk and butter from a dairy which the tuberculin test shows to be free from tuberculosis, rather than from one in which the animals have, during calfhood, been inoculated with living human tubercle bacilli, even though these bacilli have been greatly attenuated.

While looking at the money side of the dairy business, we should not shut our eyes to the close relation this business bears to the public health. The evidence that human tuberculosis is transmissable to cattle is as firmly established as any other fact can be, and that tuberculosis of cattle is transmissable to man is scarcely lacking in as strong evidence. The tubercle germs, as found in cattle, are much more virulent than those from the human body, as shown by inoculation into cattle and in small experimental animals as rabbits and guinea pigs. And reasoning from these facts, the conclusion is that the tubercle germs from cattle are more dangerous to mankind than the bacilli coming from man himself. A direct experiment to demonstrate this is, of course, out of the question. But the evidence of accidental inoculation of persons through wounds, while handling the carcasses of tuberculous cattle, is not lacking. Also, the infection of children of healthy parents from drinking milk supplied by a family cow affected with tuberculosis, has been reported time and time again by careful observers. Dr. Luckey has mentioned the fact that in the slaughter houses there has been noted an increase in tuberculosis in hogs, within the last few years, and that this has been traced to the large dairy centers where the skim milk is fed to pigs. If pigs contract the disease so readily, why not children? We have been accustomed to regard the pig as a very resistant animal.

There is a difference of opinion among bacteriologists as to whether the tubercle bacilli of cattle is identical with that which is found in human tuberculosis. This is not a matter of such moment as the fact that both cause disease in the human being. My firm belief is that the extermination of the disease in cattle will be followed by a marked improvement in the health of the human family.

I know that it is the desire of the dairymen of this Association to put upon the market *pure, healthful* dairy products, but this cannot be done from a herd containing tuberculous cows.

In closing, let me repeat and emphasize my belief that nothing is more important for the success of the dairy industry of this State than to free our herds from tuberculosis,, and to keep them free. The aid which the Board of Agriculture is offering through its veterinary service is timely, and I hope that every member of this Association will call on Dr. Luckey for a test of his herd—and of every animal added thereto.

Mr. Marple—I would like to ask Dr. Luckey what his opinion is of the per cent of tuberculous cows in this State.

Dr. Luckey—I don't know how many herds of this State are affected with the disease, but I think there is only a small per cent of either beef or dairy herds.

Mr. Carroll—Is it a fact that tuberculosis spreads more rapidly among dairy cattle than beef herds?

Dr. Luckey—No. Whenever tuberculosis gets in a herd it spreads among them all, regardless of breed.

Mr. Carroll—The reason I ask is I saw an article in Hoard's Dairyman stating that the disease was more extensively developed in dairy herds than among beef herds.

Dr. Luckey—There is no ground for that conclusion. The registered beef and dairy cattle are kept very much alike; and in this connection I will say that I notice tuberculosis spreads very rapidly where the animals are fed from a common trough, or where they are fed on the floor, because after eating what one animal leaves is swept along to the feeding place of another, and one animal eats after another. On the other hand, there were tuberculous cows in a herd for five years, and out of 50 head only 16 contracted the disease. In this case they had individual troughs—each cow stayed in her own stall.

Mr. ———What are you going to do with the reacting cow?

Dr. Luckey—We expect to require the owner to isolate the diseased animal and not sell it for breeding purposes. If he is an honorable man he will not want to sell it. He will want to isolate it for his own protection.

Mr. Wright—I am very much interested in this question. It is a very serious thing with us if the situation is as bad as pointed out. We always feed skim milk and buttermilk to our hogs. It is quite prevalent with us in the dairy section. When anything goes wrong it is all laid on the old cow; and I am glad to hear the veterinarian take the part of the dairy cow. But I suppose the disease is most prevalent among them because they are kept a good many years longer than the beef cow.

SOME SERVICE A STATE DAIRY AND FOOD COMMISSION MAY RENDER THE CAUSE OF DAIRY PROGRESS.

(By Hon. J. Q. Emery, State Dairy Commissioner, Madison, Wis.)

A very valuable service a state dairy commission can render the cause of dairy progress is to lead dairymen out of the maze of calf paths in their thinking and practice, and into straight, modern, scientific pathways.

A service that a state dairy commission may render the cause of dairy progress is to procure the enactment of good dairy laws. Among these may be mentioned laws fixing a minimum standard for milk and cream; prohibiting adulteration of dairy products in any manner; providing for cleanliness and good sanitation in barns where cows are kept for the production of milk that is to be sold or manufactured into human food; requiring cleanliness and good sanitary conditions in creameries and cheese factories and their surroundings; requiring that to be merchantable, milk must be produced under clean and sanitary conditions, handled in clean cans and utensils and not allowed to become contaminated by remaining in barns where cattle or other animals are kept; requiring all milk dealers, who produce their supply in such a way as to call for the return of cans over railroad or boat lines, to empty those cans before the milk becomes sour, and thoroughly wash and cleanse them before return shipment; prohibiting any false manipulation of the Babcock test or any under-reading or over-reading of the same, or the making of any false determination by the Babcock test or otherwise in the payment of patrons of creameries, cheese factories, etc; requiring that the standard unit for testing cream by the Babcock test shall be 18 grams by weight, and prohibiting the measurement of cream by the piepette, where payments are made on the percentage of fat in such cream; requiring records to be kept at creameries and cheese factories that shall be open to inspection, and prescribing a legal form of statement to be made to patrons of creameries and cheese factories in the payment of dividends; and giving the dairy commission authority to enforce such measures as may be necessary to secure cleanliness in and around any factory, building, dairy or premises where any dairy product is manufactured, handled or stored, when such product is to be sold or shipped.

Having succeeded in procuring the enactment of good dairy laws, the dairy commissioner can promote dairy progress by procuring a competent and sufficient corps of assistants and inspectors to enforce those laws. In the selection of his assistants and inspectors the cause of dairy progress can be served by the appointment of only the very best and most competent men available for doing this great work. These men must be experienced experts, and should receive compensation commensurate with their skill and efficiency. As these men are to bear the gospel of cleanliness to every creamery and cheese factory in the State and to every patron of the creameries and cheese factories and to other producers of dairy products, the men appointed to this service should be men who are themselves habitually neat, clean and tidy in their own personal habits and appearance; for what could be more out of place than an untidy inspector going to a creamery to secure cleanliness. To an untidy inspector, the shiftless cheese or butter maker could retort, "physician, heal thyself." Only such men must receive appointment as have by eminently successful experience in creameries or cheese factories demonstrated their efficiency, not only as the most skillful of makers, but also in what is equally important, as managers of men. They must be gentlemen. Their success in operating creameries or cheese factories should have manifested itself in educating their patrons to furnish the creamery or cheese factory with clean milk that has been properly cared for and delivered always in cans scrupulously clean; for only men of such character and efficiency can be relied upon to lead in the pathway of dairy progress. Above all, these men must be progressive men. They must have a progressive spirit. Their past experience must have demonstrated that they are such men. They must be up to date. They must be twentieth century men and they must be capable of exercising strong and positive leadership. They must not be mere floats along the current of popular opinion. If the blind lead the blind both shall fall into the ditch.

With laws of such character as I have indicated and such assistants as I have described—and none other shall be tolerated—a state dairy commission may render valuable and substantial service to the cause of dairy progress by the enforcement of the laws. To this end the commissioner will cause every creamery and cheese factory to be critically inspected, and that frequently. I emphasize the word critically, for if any other kind of inspection is done, it is time and money wasted.

The inspector must go to the creamery or cheese factory for the purpose of improving conditions there. His mission must not be to promote self-satisfaction with existing conditions. The ever-present spirit and purpose must be that of progress, improvement, for it is unquestionably true that not very many creameries or cheese factories in the land are in such condition that they cannot be improved. We can justify the employment and payment of these inspectors only for the purpose of improving existing conditions.

That each inspector may be able to do efficient service, the commissioner must see to it that each assistant or inspector is provided with a neat case containing the very best implements or supplies that are required for doing up-to-date work.

Each assistant and inspector should also be supplied with a suitable case for containing bottles for taking samples of milk to be tested when the factory is not provided with the necessary means for testing or where the apparatus in use is defective.

Thus equipped each inspector of the kind described is prepared to render the cause of dairy progress very efficient and much needed service.

Butter makers and cheese makers are not all familiar with the use of such instruments as the inspector will carry for making their own work accurate and of the highest quality. The inspector's business at a creamery is to examine carefully and inquire into every condition present in that creamery or cheese factory, to ascertain what is right and what needs improvement. This he does in the presence of the maker, who thereby is many times enabled to make improvement in his own work and methods. It raises the standard in the quality of the maker's work.

The inspector goes to the creamery or cheese factory early in the morning. He procures a list of the names of the patrons. He has his bottles ready for taking a sample of each patron's milk as delivered. He examines the scales to ascertain if they are accurately balanced, or are so set as to cheat the patron out of a few pounds of milk each morning, and lay the foundation for the report of a large over-run; for not only does inaccurate weighing defraud the patron, but makes a false report and impression as to the amount of over-run and the price paid per pound for butter fat. An over-run of more than 16 per cent in whole milk or of

18 per cent in cream under average factory conditions should be prima facie evidence that false manipulation of the weighing or testing has occurred, or both. The kind of competition thus engendered is fraudulent, and destructive to the best interests of the creamery industry. The inspector stands by the weigh cans and inspects the work of the man who receives the milk, as well as the milk and cans of the patron. He scrutinizes the method of taking the samples of milk for testing and how the composite samples are cared for. He observes closely whether or not the man who is taking in the milk receives any unclean, unsuitable or unlawful milk or cream. If unclean, unlawful or otherwise unsuitable milk or cream is offered by the patron and received by the creameryman, he warns both alike concerning the unlawful and unwise practice. At times he will instruct the patron as to the proper way to wash and care for his cans and the proper method of caring for milk or cream. He shows him how the quality of the product, and, therefore, the price, and hence the profits of the patron are ultimately dependent upon the clean and wholesome character of the milk furnished by patrons. He discloses to the patron how some rations, fed to the herd at improper times or in unsuitable quantities, may injuriously affect the entire output of the factory, thus imposing a loss on all the patrons.

He notifies the patrons to meet him at the factory late in the afternoon or early evening. With the samples taken, he then proceeds to make the Babcock test for fat, a lactometer test for watering or skimming, and a Wisconsin curd test to determine the character of the milk of each patron, as to its cleanliness or the kind of care it has received.

When the patrons meet him later in the day, he makes known to them the per cent of milk fat found in each patron's milk. If he has reason to suspect watering or skimming of milk by any patron, he furnishes a sample to the State chemist for more detailed analysis.

He exhibits to them the results as shown by the Wisconsin curd test. This is an actual and accurate demonstration to each patron of the character of each patron's milk. Here they see from one patron's milk a curd that is of fine, velvety, firm texture and having a clean agreeable flavor. This is a demonstration that the patron's milk from which this curd was formed was produced under clean conditions, quickly cooled and otherwise properly cared for. He exhibits the curd from another patron's milk that has in it many gas holes or "pin-holes," so called. This has a tainted flavor. This peculiar texture and flavor are due to gas forming bacteria. They have their origin in uncleanliness of some sort or are due to the rapid development of gas forming bacteria, owing to the lack of suitable care of the milk. It has been demonstrated that the presence of only one fly in a can of milk may add 50,000 bacteria to that milk, a large proportion of which bacteria may be of the gas producing variety.

He shows them the curd from another patron's milk that is spongy in texture and has a very offensive flavor or odor. He explains to them that this is due to conditions worse than those of which No. 2 resulted. He explains to them that it is impossible to make the best quality of butter or cheese from such milk, and further explains to them the great loss that is being sustained by the butter or cheese factories, due to bad milk. He lets them see the curds produced from each patron's milk, that each may see and know for himself that there was a difference in the quality of milk furnished by the different patrons, both as to fat content and cleanliness. He instructs them how the good milk and how the bad milk are each produced, and he warns them against the supplying of bad milk as being wrong and unlawful and liable to lead to prosecution if continued. Having taken samples of the milk from the last gallon or two of the patron's milk as it was delivered from the cans, and having passed that milk through filters of absorbent cotton or through filter paper, he exhibits to them the actual filth thus taken from their milk on the morning of his inspection. These exhibits surprise as well as instruct them and drive home the truths that the instructor has been teaching. With such kind of work, he is not dealing in abstractions. He is making his instruction concrete. It is real instruction.

He illustrates and explains the use and reliability of the Babcock test when skillfully used. He explains the requisite conditions for securing accuracy of test. He has instruments and uses them to test the pipettes to see if they are absolutely correct as to size. He tests the calibration of the bottles to determine its accuracy or inaccuracy. He applies his speed-tester to the Babcock to ascertain if the operator is running it at the rate of speed to give accurate results. He tests the sulphuric acid to find out if it is of the correct strength. He ascertains at what temperature the operator reads the test, and if he measures the fat column from the lowest point at the bottom to the extreme top limit of the meniscus, as he should; and he tests the skim milk for butter fat and also the butter milk or whey.

He inspects the weigh cans, pipes and pumps, churns, vats and vat gates and everything connected with the factory to ascertain if they are kept scrupulously clean, and does the same as to the floors, walls, surroundings; nor is he to overlook the maker.

In his inspection of the surroundings he gives particular attention to the drainage, and where that is defective he suggests the use of the septic tank or other suitable means for securing adequate drainage.

The inspector realizes that inadequate drainage is a prolific source of unsanitary conditions in creameries and cheese factories, and therefore he seeks to correct any imperfections of drainage. Being a competent judge of the commercial product, and to ascertain the quality of that product, he inspects and scores the same. This should become a means of instruction to the maker, who learns thereby where improvement can be made, and how that improvement is to be gained. As he is there to secure improvement, he must speak plainly and tell the truth.

He should have a knowledge of the proper construction of refrigerators, because they too frequently are only small boxes partitioned off from the rest of the factory where some ice can be left to melt. Refrigerators properly constructed would stop numerous annual losses from mould.

If conditions are bad or unlawful, he warns the maker or manager that they must be changed within reasonable time or prosecution must necessarily follow; and he prosecutes if the change is not made. He may go to the patron's premises and point out the changes to be made. The curd tests give him a cue as to what patrons need his inspection. If he finds the milk at the factory below the legal standard of butter fat, or otherwise unlawful, he visits the farm and takes samples there to test them. When there is a discrepancy between the test of the milk at the factory and that of the farm, he has the evidence that 99 times out of the 100 will lead the defendant to plead guilty when prosecuted for furnishing milk below the legal standard as to butter fat.

He will report to his chief on blanks prepared for that purpose the results of his inspection. The commissioner's office may thereby become a bureau of dairy information.

A state dairy commission can render valuable service to the cause of dairy progress by making careful and critical inspection of city milk supplies. Samples are to be taken and tested for butter fat content, for watering or skimming, for the use of preservatives, and a curd test applied to determine the quality of the milk as to cleanliness and suitable care. This is a more practicable and valuable test than the bacterial count. If possible, this inspection is to be followed by an inspection of barns and premises of those furnishing milk. This is a field to which much time and effort may be given with much profit to the consuming public. In proportion as the milk furnished to our cities becomes possessed of the characteristics of cleanliness and purity and proper care, will the demand for such milk be increased. The consuming public, however, must remember that milk of such high quality cannot be produced and furnished them as cheaply as inferior milk.

A state dairy commission can render valuable service to the cause of dairy progress by issuing quarterly or semi-annually bulletins in which is plainly and truthfully set forth results of the inspections made. This will show to the creamery or cheese factory makers or managers and their patrons the effect of the bad work or the good work they are doing, and its final effect on the quality of the butter or cheese product, and consequently upon the profits.

In the great battle for dairy progress and against ignorance, uncleanliness and bad practice, a state dairy commission can render valuable service to the cause by being at the front and on the firing line sounding forth the bugle call, "Forward," in tones of such clearness and force and persuasiveness as to be everywhere heard and heeded.

But the state dairy commission must be supported. There is no organization in any state which can or should give greater aid and support to the dairy commission than a state dairy association. In my own state the state dairymen's association has been instrumental in securing more effective legislation for the promotion of the dairy and agricultural interests than any other agency. It has secured the establishment of the dairy and food commission; it conceived and secured the establishment of the first dairy school on this continent. In 1900, at the meeting of the Wisconsin Dairymen's Association at Watertown, Professor W. A. Henry said: "This Dairy Association is the parent of the Wisconsin College of Agriculture. What that college is today and what its ambitions are rests largely in the backing and help it receives from this Association; and as a child we are loyal to our parent." To that association also is largely due the originating of the Wisconsin Farmers' Institute.

Of Wisconsin farming in the early seventies it might well be said that

"Many men wound in and out,
And dodged and turned and bent about,
And uttered words of righteous wrath,
Because 'twas such a crooked path."

The continued raising of wheat had well nigh robbed the soil of its fertility, and the chinch bugs were running riot over the wheat fields, made scant in yield by following the process then in vogue. But in 1872 a few pioneer thinkers became convinced that Wisconsin farmers were following a "maze of calf paths" in their thinking and practice. They believed that some of the calf paths in the minds of those farmers should be obliterated and new paths opened as conditions for successful achievement. They determined to do something to make the crooked paths straight, and so they organized the Wisconsin Dairymen's Association. They swore allegiance to their own reason and their own intelligence and they have been true to their oath. All through the successive years they have been putting to rout the enemies of dairy progress.

Without a market for their products, they waived the magic wand of their influence over the railroad officials, and in response refrigerator cars were placed at dairy centers to be loaded with Wisconsin cheese and butter, to be borne to the best dairy markets of the continent or to the seaboard, and thence to the great dairy markets of the old world, there by their merits to command the highest prices.

In their need and extremity they called for some easy and accurate means for measuring the butter fat content of milk and cream, and right royally did Dr. Babcock, a member of that association, respond with a test that bears and must immortalize his name.

They aided in bringing into existence great institutions that have made discoveries and inventions which have revolutionized the thought and practice of the dairy world, and that have been adding to and continually increasing their own productive powers.

Their thoughts and experiences chronicled in the Dairy Press, to which their own necessities and their own genius gave birth, have led the march of dairy progress across the continent and have influenced for good the dairy thought of the world.

The work of that association has ever been pioneer work; but it has been progressive work, and in my judgment, in its devotion to and efforts to promote advancement in everything connected with the dairy and agricultural interests of the State, is such as to make it in spirit and result worthy of emulation.

I appeal to the State Dairy Association of Missouri to be energetic, progressive and loyal in support of its State dairy commission. "Progress" should be the watch-word. We need greater advancement in the selection, breeding, feeding and care of the dairy herd; greater advancement in the production of good, pure milk from healthy cows and in the caretaking of the milk and cream; we need greater advancement in the quality of dairy products; we need greater advancement in establishing and maintaining a reputation and market for dairy products; we need greater advancement in the development of high-class dairymen; we need to make advancement in securing for ourselves better profits by reducing the cost of production to the lowest point by the highest efficiency possible in the methods that are used. We need to catch, and to hold, and to be moved by the spirit of the twentieth century.

We need to allow the dairy cow, the gentle-gifted dairy queen, to exercise her sovereign sway over our purposes, our hopes and our business destiny, with the assurance that to each intelligent and kindly act on our part, in her behalf, she will respond most bountifully. Nor let us fail to woo her by our most bewitching, considerate and intelligent care and attention, and she will yield to us abundantly of her golden riches.

Permit me, in conclusion, to say that that person must indeed be in a "maze of calf-paths" in his thinking who fails to realize that the business of modern dairying calls forth in multitudinous ways those intellectual activities in the tillage of the soil, the selection, breeding, feeding and rearing of the dairy herd, the manufacturing and marketing of the dairy products, that develop a strong intellectual manhood; and that any large success in the very nature of the case calls into constant activity those kind, considerate, attentive, unselfish, benevolent acts that cultivate and strengthen the moral nature; and that the successful doing of all these things brings into activity man's will powers, and all this tends to the evolution of a high type of manhood, which should be the ultimate end of human effort.

DISCUSSION.

Mr. Marple—What do you do in your state when you find a man reading the test too low?

Mr. Emery—Well, I will tell you what we do. We are trying to improve all the while. We begun only two years ago. It was my own experience as a patron of a creamery that caused me to use my efforts in securing the passage of a bill making it a misdemeanor to in any way falsely manipulate the Babcock test and to under-read or over-read that machine. We got the bill passed. It is not so easy to enforce it in this country. When we send out men to make tests we find they will vary. When we investigate and find a man reading the test too low we warn him what the law is. Usually when they know we have the power to enforce the law, and that we are making investigations to see that the testing is done properly, the corrections are made at once.

Mr. Marple—Have you ever had any trouble in having the test read too high?

Mr. Emery—Yes, that is just as great an offense as reading it too low. When we learn of this being done in the creameries we send out men to investigate, and usually they are successful in convincing them of the error of their way—but it is a great work. We are improving in it—we have not reached the millenium by any means, but we are working towards it.

Mr. Clark—What kind of a stall would you recommend?

Mr. Emery—There are quite a variety of stalls. There is the

Clark modern stall—individual stalls, where the floor is just as clean as can be all the time. There is a chain fastened behind the cow; all the droppings go into the gutter. Then there are the Bidwell and McCleary stalls.

Mr. Clark—Are they all patented?

Mr. Emery—Some of them are.

Mr. Miller—What is the proper way to tie a cow in a stall?

Mr. Emery—That is a matter of personal judgment. I would not tie her at all. Would have individual stall for her and have a chain behind her. In this stall she can lie down and be comfortable. The first thing she wants is comfort—then cleanliness and good wholesome air. These stalls I have in mind the cow is not tied at all.

Mr. Miller—I have heard some men say the best way to keep a cow in the stall was by a stanchion.

Mr. Emery—If I were to tie my cow I would use Mr. Hoard's stall; a modern stall where the cow is tied around the neck; a most excellent stall—perfectly clean. It is arranged so that the manger in front slides. When the cow is standing her head comes against the manger and pushes it back; then it is placed right in front of her when she is feeding. She keeps just as clean as those in the pasture. I think this stall is about as near perfect as any I have ever seen. There is no patent on it.

Mr. Marple—I think we need to have this business dignified by the endorsement of people who, by virtue of their position, lend dignity to it. Unfortunately, we have an idea in this country that it was beneath our dignity to milk, and it is a hard lesson for us to learn. Unlike the old-time Missourian, who is loyal to the teachings of his forefathers, we cannot get over that idea that it is beneath our dignity to go out on the farm and milk dairy cows. But that has been overcome by the dignifying of the business through the interest manifested by somebody in a position to know and by their interest to give it dignity. So these men, who have come here to talk to us and to encourage us and to make us better and get better results from the dairy, have brought an influence to bear on this business through the dignity they have lent to this meeting and to the dairy business in a general way. Gov. Folk says that's quite a lot of dignified looking men you have here at the State Dairy Association. We compare favorably with the members of many other organizations; it is shown by the signing of the bill for a dairy commissioner and by the appointment of a dairy commissioner and assistant dairy commissioner; and I am glad to say he took into consideration the wishes of the dairymen of this country in that appointment and showed that he is interested in this department and believes there is something to its future.

Mr. Emery—This meeting of your State Dairy Association should be a christening occasion, a baptismal occasion, if you please, of the oncoming generation of dairymen, who are heirs of the generation soon to pass away; but this baptismal ceremony should consist of no "mere sprinkling of diluted platitudes." By this meeting this oncoming genertion of dairymen should be led by the speakers who occupy this platform and those who take part in the discussion into the great depths of modern dairy knowledge and experience, and upon them should be poured abundantly an ever progressive and conquering spirit.

THE NEED OF A DUAL PURPOSE COW.

(By W. P. Harned, Vermont, Mo.)

The greatest benefactor is the personage who does the greatest good to the greatest number.

The most useful type of the domestic horse is the general purpose animal.

The most popular and highest-priced type of sheep is the one that combines mutton and wool.

The queen of the bovine race is the milk and beef cow.

The highest price ever yet obtained for a cow was paid for one of the beef breeds and from a tribe with the best milk record in that breed.

There is a cow question to be solved. To the average farmer and to the agriculturist, or at least to the large majority of those who live by the farm and stock, this is a very pertinent question. It is a question of type or kind. The best cow is the one that answers the purpose of the majority. Who is the majority? It is the small farmer and his family. It is his best cow for which we plead. We have the labor question and we have the race question and the tariff question, and in some places we even have the boodle question. These concern the whole people. Then we have the cow question—this one concerns the farmer, the stock raiser and his family. Now I venture to say there are many people who know these first problems are confronting the public who did not even know there is a cow question. Even we farmers are not as far along on this last question as we should be. We are not as far advanced on the cow problem as our interest demands.

How old is the cow problem? If we search the Bible records, we find this is not the latest question of the day. These dairymen and Sunday school teachers at least are fully aware of the account in holy writ of Jacob and Rachel. It started out with a love affair, but it ended by Jacob getting the girl of his choice and also the better end of a large herd of cattle—you will remember how Jacob traded with his father-in-law, wherein Jacob was to have all calves that were ring-streaked and striped—how he placed striped sticks in the watering place and the new born cattle were colored so they belonged to Jacob. This was the beginning of the cattle problem, and from that ancient time down to the present men have been trying to breed certain colors and certain forms and certain qualities into their herds which they desired. Then it was a question of color; now it is a question of quality or a combination of qualities.

UNIVERSAL DEMAND FOR HER.

We do not believe there is a domestic animal today, as conditions now exist, in more universal demand the world over than the dual purpose cow. No farm east or west but is benefited by her most useful combination, unless we except the exclusive special purpose dairy farm. The strength of her claim is the universality of her sphere. Perhaps her most natural home is on the small farm or the average farm. Her annual credit account is a good supply of milk and butter for the family and a lusty, vigorous calf that matures into a high class carcass of beef. In this capacity she turns to the very best account. When her best working days are over and she is dried off, she readily and quickly fattens off into a fine carcass, and the last account of her on the block is no mean consideration. We are far from being at war with any improved breed. The scrub breed is our only enemy. Against him we will combine forces with any recognized breed. We envy not the special purpose breed. He also has his sphere, and certain conditions call for him. But there is a special purpose breed and there is a dual purpose breed. Each will adapt itself to conditions that suit. The dual purpose is for the many, for the masses—the special purpose is for the few, for the classes. I wish to illustrate this distinction by a letter lately received from a breeder whose judgment I regard first class. He had visited a herd of note which I had not seen, so I wrote and asked him about his visit and the herd. He answered about the herd in question, saying: "It is a large herd, in fact, it is three herds; breeding herd, a show herd and a herd of nurse cows." Now, the breeder of real dairy cattle does not know much about a herd of nurse cows, but the breeder of the special beef type knows about them, and if he is a successful showman today at the Kansas City Royal and the international, he has had experience with nurse cows without drinking the milk or selling the cream. These fine, fat calves consumed that, and say nothing. You can only detect it by the big carcass and soft coats. Or you can satisfy your curiosity when at the big shows, if you follow these fine fellows, when let out at milking time. This is all right to develop the exclusive beef type, but it is not the class of cow that furnishes milk for the family and butter for the board. It is not the class of cow for the small farm. It is not the class for the thousands of large families of moderate means and small estates. I have thought one of the most pitiful sights in a herd is to see a fine, large, fat 1700-pound cow walking around followed by a little half-starved, puny calf, with hardly enough strength to keep up, because the dam barely gave milk enough to sustain life, and the owner did not have an extra nurse cow.

A MEDIUM FOR TWO EXTREMES.

There are two extremes—one is all cow and no milk and the other is all milk and no cow. There is a happy medium, and it is this medium the small farmer and his family demands. It is the call of the masses. It is the demand of the majority—she is coming to her own, and she will not be turned away. It is the dual purpose. She is queen. I want to refer again to the fine herd mentioned above—I mean the fine herd with the nurse cows. This description is not overdrawn. I have seen just such herds more than once. This class of breeders aim at one thing. They go in to raise high class bulls to go out and head other herds. They succeed in their purpose—these young bulls are bought by breeders and go in service, perpetuating their kind. There is a great evil in this method. These nurse-fed calves are very attractive; they are fixed for visitors. Truly they are on *dress parade*. The unwary and the new beginner are captivated on sight, the price is also high enough to make the calf attractive, but the nurse cow and the extra work must both be paid, and when the price is published it is a boom both to the buyer and the breeder. The price will be published and commented on far and wide, but the nurse cow will not even be mentioned. She is cheated out of her part of the glory. The big milkless dam gets all the praise, or it may be the sire that is working up a boom. The calf never tells the tale till taken to his new home, minus the nurse cow and put on farm feed where he belongs. It is not an economical process in common farm life, and it is not practical. Normal prices and normal conditions will not justify it on the average farm with average means. The game is worked largely on the enthusiastic new beginner and many disappointments follow. It is a great injury to the substantial and steady improvement of our common farm stock. How pleasant is the contrast where the new beginner falls into better hands and makes his purchase from the conservative, practical breeder of the useful common-sense sort. Real breeders will send out stock that have the innate quality to do well.

The more fortunate beginner takes home his purchase and it does well from the start. This will be the case where the ancestors possess in full measure the necessary qualities of the real improved class fed right and nursed by its own dam.

BEST MILKERS ARE BEST BREEDERS.

Before quitting my subject I want to refer to one phase of it, which is not included in the subject proper, but is suggested by it. I am expected to show the necessity or need of the dual purpose, but some *exclusive dairy* breeders seem almost to think such a cow cannot be bred. I have seen men worked up to the conviction that such a theory is inconsistent, and I have been surprised that so sensible a class could be so positive in error. Really we are not confronted by a theory—you are confronted by the cow herself. Such a cow exists and we have had her in a high degree for a century. You have the general purpose horse, why not the dual purpose cow? You have a fine mutton and fine fleece in one, why not beef and milk? The Thanksgiving turkey grows feathers with the flesh, and the dual cow grows milk with the beef. While we have no text-book in breeding, there is among the breeders of beef cattle one well-established law—all four of the beef breeds will concede this: *The best breeding dams are the best milkers.* In the breed with which I am identified I can say knowingly, *we do not expect our high class show cattle from poor milkers.* The two qualities seem inseparable. It is very fortunate such is the case. If the opposite were true, the small farmer and the dual purpose cow could not be so happily joined.

DISCUSSION.

Mr. Ellis—To start this discussion, I will say it seems to me there is possibly a place for the dual purpose cow in Missouri at the present time. Our farmers have been educated up to believe that the calf is the primary thing in raising cattle and they have been wasting the milk, but they are now saving the milk as a by-product of beef-raising. We have a great many people in Missouri doing that. It seems to me the dual purpose cow would answer that purpose very well. Of course, if I was going into the dairy business, making that my whole business, I would want a special dairy cow; but if I wanted to raise beef and wanted to save all my by-product I would certainly follow Mr. Harned's advice and take a dual purpose cow. I would like to say, Mr. Chairman, that I believe that is the best paper I have ever heard read on the dual purpose cow.

Mr. Glover—I think Mr. Ellis has got very close to the situation. He said something we can all sanction. As a newspaper man and as a student of dairying all my life, I know the English language does not always express our thoughts clearly. In other words, it is hard for a speaker to stand before an audience and state his sentiments so that everybody will get the true meaning of what the speaker is talking about. We are confused. We cannot express our thoughts clearly. Now, he said if he was going to be a dairyman he would have a dairy cow; that's good—that's all the special dairy advocate needs. Then he said, if he was going to be a breeder of beef cattle he would select a beef cow that would give enough milk to support her calf; but, gentlemen, the man that keeps that kind of a cow is not, strictly speaking, a dairyman; he is a beef man. Therefore, we cannot say that the special dairy cow has any relation to the so-called dual purpose cow. I have never yet in all my travels found a man that was successfully breeding the dual purpose cow—that is, the cow that will give as much milk as a dairy animal and at the same time produce as much beef as the special beef cow. That is where the so-called dual purpose cow is held up. You cannot comprise in one animal the power of producing the maximum yields of milk and butter and at the same time the maximum yields of beef. That has never been done. I have traveled all over this country, and have never found anyone doing it—no one in Iowa or Minnesota. We will grant openly and above board that there is such a thing as a dual purpose cow, but you have never seen that animal reproduce herself; that is, she hasn't any prepotency—she will not produce a heifer as good as she is. You are dividing her prepotency, if I may use that term. You breed an animal for beef and you get a certain form; you breed for the dairy and you get another form. Now, I believe that the dairyman or the beef man of Missouri should begin with the stock he has. If he wants to be a beef man I believe he should keep cows that will produce him good calves, but I would not class it as a dual purpose animal, but simply as a beef animal, because I think that the idea of the dual purpose cow, the term, if you please, is misleading, and we want to clear it up here. It is misleading in this, that she is expected to give as much milk and butter fat as a special dairy cow, and at the same time produce beef calves. Now, if you are satisfied to sit down under a cow that will bring you from 150 to 200 pounds of butter in a year, and are contented to milk her and be an average farmer, then perhaps there is such a thing as a dual purpose cow; but we want to see the dairymen of Missouri do more than make a mere living. We want to see them have good homes and educate their children. And if you keep a cow that will yield 300 pounds of butter fat, it will be better for you. Now, have I made my position clear? I believe it is possible for a man to keep a class of beef cows that will yield a reasonable amount of milk. I believe also that if a man is going to be a special dairyman he should choose a special dairy cow; and also believe that the Missouri farmer should begin with the cows he has, and as he grows in the business begin to select cows. Select those that come from long ancestry, that have a record of producing large amounts of milk and butter, and gradually grow into the milk and butter business. It is not beyond your pocket book to have a good dairy cow if you begin slowly and grow into it. I would rather see any man grow in the business than to go into it.

Mr. Ashburn—The closing sentences of that very nicely written paper was a staggerer. It may be true—I will not say it is not true, but it staggered me. It said that the best milkers among the dual purpose cows produced the best beef calves. Now, I believe it is largely a question of type—not so much of breed nor perhaps of size as it is of type. I believe that the cow that can yield us a large amount of milk is going to be the lean cow; she is not going to carry much flesh; get the cow with a large stomach; that's her type; don't care what breed she is. Don't believe you can have the cow that will give you an equally large amount of milk and carry a large amount of flesh. She cannot do two things at the same time, and she is either going to put her food into milk or beef. If she has got the beef type she will put it into beef; and if she has got the milk type she will put it in milk. But the statement that the best milkers among that class are going to produce the best beef steers is a staggerer. I have handled that class—Durhams—275 of them at a time; high-class Durhams, kept in Northeastern Ohio for many generations for dairy purposes; and I believe I got good results and was satisfied at that time; but I say my best milkers were not my best beefers by a long ways, and I don't believe it is consistent. I have no objection to a man who wants to take that kind of a cow and wants to have a dairy side to his work and a milk side to his work; but I say stick to the doctrine that is true; and you will find that beef cow will be a great exception who will be also the copious milker, and we want to stay along lines of actual facts and know what to expect, and not expect we are going to get two things at the same time from the same cow, and that she can do two things at the same time with the same food. The trouble with a great many is, they will take an old English type of cow that is lean, has high, thin bones, the large frame, the regular dairy type—and they bring her over here and start a herd of that kind. What are they going to do when they want to change sires? They have gone and gotten the best beef sires they could get, and then have ruined their dairy type and have got the beef type. It is the tendency of the American people to do this, and it is the greatest danger in my mind with the dual purpose cow.

Mr. Bruns—I believe we will pull away from the dual purpose cow in time and give our attention to the dairy business. We should follow some special line of business. We are living in an age of specialties. We must do special work; and I believe that is the dairyman's only salvation.

Mr. Patterson—Some years ago we had a live stock breeders' meeting at Mexico, and Mr. Harned was on the program to read a paper about the cow that had all these good qualities—a very good milker and a very good beef cow; and after he had said all he had to say I just raised up and said, "Mr. Harned, I wish you would bring us such a cow as you describe." "Well," he said, "she ought to be somewhere." I said, "yes, she ought to be somewhere, but she has not shown herself." When we get to believing in a thing it is hard for us to break away from it—it was hard for me to break way from shorthorns. I liked them; but when I got to using the Jersey animal I thought she was better, and I worked up my herd with them. I say the sooner you break away from that dual purpose cow the better off you will be. You might as well make up your mind to it as soon as you can if you want to make any money.

Prof. Washburn—I have been much interested in that paper. I am a dairyman. Have been traveling for the past two years among the farmers of this State, and while I find they are frequently wrong in their conclusions, yet I find that in many instances they have a whole lot of foundation for their judgment, and therefore I say I have sympathy and "charity" for Mr. Harned in the conclusion he has reached, as expressed in his paper. Might he not also be right? I understand that he said in his paper that the dual purpose cow, which gives the most milk, produces the best show steers. We all know the young animal liberally fed will grow more rapidly and put on meat more rapidly than the young animal not well fed. The animal well started will show that start for a long time. And cannot the beef animal produce milk enough to raise that calf in a way that she can be used for show purposes?

Mr. Ashburn—Suppose you wanted to show her at two or three years of age?

Prof. Washburn—I don't claim to be a beef man; but in two years might not that first six months of abundance of feeding, or, on the other hand, of scanty feeding, still be perceptible? I think that is a point often overlooked.

Mr. Ashburn—He is talking about the dairy type, isn't he? When we are using a dairy cow, it is not nursing the calf. It is not the nurse calf we are after then. It is the type we can get out of that steer, that is from the dairy side of it.

Prof. Washburn—Are you sure he had reference to the dairy type when he said that? Might not the animal of ordinary type abundantly nourished make as good a show steer? I am not defending the dual purpose cow at all. Last winter when the temperature was 25 degrees below zero and the snow was deep, in Columbia, a neighbor of mine had a Jersey cow—apparently full-blooded—which he kept in a concern which he called a barn—it had a top and three sides. The snow was deep in there. The cow would either have to stand up all night or lie down in the snow. When a man can give a cow such treatment as that he is not ready for anything better. He is not ready for the special cow. When we can get them to take care of what they have got, then it will be time to tell them what to do next. Last December I was sent up into the northwestern part of the State, and had to make a night change, so that at 2 o'clock in the morning I was awake and was looking out the window; everything was covered with snow; the moon was shining bright, and everything looked very beautiful. But all at once the beauty was entirely gone, for there on one side of the fence, all humped up in the snow, was a cow. We have got to teach the farmers to take care of what they have got, then when they get so they can take care of a dual purpose cow we can land them on the special purpose cow.

DAIRYING A PROFITABLE BUSINESS.

(By Hon. H. R. Wright, Iowa State Dairy Commissioner.)

Mr. President, Ladies and Gentlemen—I have not come down here to boast about the pre-eminence of Iowa as a dairy state, but only wish to say some things about Iowa which will make you so envious that you will go and do likewise. Iowa is the greatest butter-producing state in the Union. We make ten per cent of all the butter produced in the United States. We make nearly twenty-five per cent of all the creamery butter made in this country, and for the year ending the first of July last the state of Iowa has made 82,000,000 pounds of creamery butter, which has a value, at the New York price prevailing, of twenty million dollars.

The twenty million dollars we got for that creamery butter represents a sum of money that our farmers made more than yours did last year. It represents a sum of money that you might just as well have had if you had milked as many cows and made as much butter as we did, and as you might easily have done.

The butter that a man makes is a net profit to him. Consider two farmers situated exactly alike in every particular. They have the same number of acres of land, the same number of cattle and hogs, the same amount of machinery. They pursue their farming operations exactly alike, with one exception. It would seem that at the end of the year each should have the same number of bushels of corn and tons of hay, that each should have the same amount of farm products as the other. But suppose one man milks his cows and raises his calves on skimmed milk and corn, and the other man lets the calves run with the cows; the dairyman will have just as many bushels of corn and tons of hay and acres of pasture as the other man; he will have just as many calves, and just as good calves, if he knows his business; he will have just as many pigs, perhaps more pigs because he will have skimmed milk to raise them on, and the other fellow will not; he will have absolutely everything that his neighbor has and in equal amounts, and he will have twenty-five to fifty dollars for the butter that he will sell from each of his fifteen or twenty cows. That is to say, he will have somewhere from four to seven hundred dollars more in money than the other man who raised just as many crops, but didn't utilize them in the same way. The butter that a man makes is a net profit to him. That is why we have twenty million dollars that you people never saw. The butter is a profit to the dairyman, to his county, his community, his state, and makes for high-priced land and good farming.

We have 655 creameries and skimming stations. In the past two years the southern half of the state and the western part of the state have developed enormously in the dairy industry. We now have the state pretty well covered with creameries, and it is easy to predict with reasonable confidence that the amount of butter we will produce in future years will be still greater, and it is easy to predict that the amount of money that you will get out of your butter production will be greater and greater as the years go on, for this reason—it is the law of the land, you will have to do it. Your lands will increase in value, as ours have, and you will be obliged to get greater returns from them, and the only way to do it, aside from better general methods, is by the practice of dairying.

Now, did you ever think of this: The farmer keeps no kind of live stock, with the exception of cows, on his farm unless he gets two returns every year. The farmer cannot keep sheep unless they bring him both wool and lambs; he makes the old mare work and pay her board and raise a colt besides. We could not keep hogs in Iowa or Missouri if they reproduced themselves in the ratio of one to one, as cattle do; and so, if one expects to get profits from cattle on high-priced land, either in Iowa or Missouri, or elsewhere, he must get two returns from them, the calves and the butter. So it is easy to predict that the dairy business in Missouri is bound to increase. You will have to obey the law of the land.

The dairy business tends to a uniform distribution of the wealth of the community. In the dairy sections of Iowa, or of any other state, you will notice that the farms appear very much alike. They all have good houses and big barns, windmills and well-kept fences, and there is a general air of prosperity. The farmers all milk cows and send their product to the creamery and they have money in sight. Then visit some section where the dairy is not a large item. You will find, perhaps, a magnificent farm with a large house and a half dozen big barns, windmills and feed lots, sheds and other things of that kind, and then you will ride half a day past farms with small houses, little stables and no evidences of anything more than a bare existence for their occupants. The man with the big barns, by reason of his superior business ability, in feeding cattle perhaps has all of the accumulations these other fellows should have had in the last decade, or longer. This cannot happen in a dairy section. The man that milks the cow gets his money in small quantities and it doesn't drift into the hands of some fellow with superior business tact. This uniform distribution of wealth in a community is a mighty good thing for men of small means, and it is perfectly safe to urge the farmers to go into the dairy business.

Don't worry about the probability of over-doing the business. There is nothing in that. There is too much confinement and hard work and head work about the dairy business to suit everybody. There are plenty of men who don't like to work quite enough to be successful in the dairy business, and for that reason the business will not be over-done, and for that reason the business is a safe one for a man who will do the work and submit himself to the confinement. And then, the price of butter is almost a uniform price. The average yearly price of butter, that is, the price for which a man sells the whole of the butter produced by the cow in the milking period, is very nearly uniform, and the average price of butter for a series of years is almost on a dead level, and the price is always high.

The money that a man makes from the cow comes to him in small amounts, and with them he pays his running expenses. When he sells his hogs or cattle he has money to pay off larger bills. The dairy business is a cash business. It enables the farmer to look the store-keeper in the face when he meets him, because he doesn't owe him money. The dairy business makes for more wealth, better farms, better buildings, for pianos and top buggies, and education for the children, for general prosperity for the community, for better times for the farmer and his wife, and everybody with whom they come in contact. There is no line of agriculture that is more certain and safe and profitable than the dairy business.

QUALITY IN DAIRY PRODUCTS.

(Hon. Ed. H. Webster, Chief of Dairy Division, Washington, D. C.)

I have heard so many sides of the dairy business discussed since I have been here that I feel you are pretty well on to the situation and don't need much outside help. However, there is one matter which has been discussed only in a general way, and that is how to get *quality* in our dairy products. I believe you will agree with me that that is a most important thing to you as the producer of milk, to you as agent who is buying the milk, and to you as a manufacturer of butter. The greatest question that presents itself to you is the matter of quality, and you cannot let it go by without serious consideration. In dairy work there are a few principles we must not forget that will tend to either make for success or failure, so far as quality is concerned. We see a great deal in the papers nowadays about conditions that surround the milk supply of our cities. By some expensive buildings are being put up, and thousands of dollars are being put into plants for the purpose of producing a pure article of milk. The idea seems to be that all this is necessary in order to produce a pure article. It is seemingly forgotten that the production of pure milk does not depend on expensive buildings and machinery, but that it all depends on the man producing this milk. The milk distributor, the butter maker or the cheese maker can do nothing; he is absolutely tied, unless the farmer will produce for him a first-class article to work with. A man can go into our butter factories and make butter out of cream a week old, but he cannot make good butter—that kind of butter is hard to sell.

I have been told all around by creamery men that one of the greatest questions that is coming to the dairy business, that is up to the dairyman, is the question of quality in butter. If our creameries can get a good quality of cream that will make good quality of butter, which will command the highest price on the market, the profits will come back to the producer; but if butter is made that brings two or three cents less to the pound, the producer of the cream has got to take that less—he must bear the brunt of it.

Now, how can we produce a good quality of cream? In the first place, the matter of cleanliness is all important, and this is something so many of us do not understand. We think that the only dirt there is, is the dirt that we can see and knock off with our hands; sure enough, that is dirt—but there is in our work as dairymen a possibility of putting dirt into our milk that we cannot see. The average milker does not realize this, the average dairyman doesn't know he is having any trouble along that line until he gets word from his creamery that his cream is bad. The question of dirt is largely a question that involves the study of bacteria. If we inoculate our milk with germs of any kind, these germs are going to grow and develop in the milk, and it breaks down certain parts of that milk; it is the breaking down of those parts that gives the milk the peculiar flavor we sometimes get; and when we speak of that "cowy" odor, it is caused largely from the dirt that gets into the milk pail; and the butter or cheese made from that milk will have the same characteristics; the buttermaker cannot get rid of it.

Must Have Clean Cows.—One of the essential things in getting clean milk is to milk clean cows with clean hands. You may have heard these things time and again, but it is a thing that ought to be emphasized again and again, because it is a most serious proposition with you. That cow must be clean when you milk her. You will sit down and go to milking when the udder is loaded with dust and straw and, of course, that dirt goes into the milk pail. Now, if the dirt you can see was all that went into the pail, you would not have much trouble; we could run it through the separator and take that dirt out. Some people do that and think that is all that is necessary; but each particle that goes into that milk contains something else besides the dirt we can see. It is loaded with germ life of various kinds. That germ life enters the milk when it is warm, when the conditions are best for growth—they are of minute growth—just as when you put a seed of corn in the warm soil, and under right conditions of warmth and moisture and sunshine, that seed will begin to grow, these germs get into the milk and the conditions are just right; there is moisture and food and warmth, they grow very rapidly, they multiply themselves every few seconds, their reproduction is enormous, and just as long as we leave the milk under warm conditions those germs will continue to develop and the milk will sour. The first step is to keep these germs out of the milk, and farmers ought to recognize that fact. It is not the dirt he can see, but it is the bacteria on that dirt. The air in the barn, if not kept pure, becomes full of germs. When the cow is fed hay, the air becomes full of dust, which carries great numbers of germs. When the cow is milked in these barns with the air in this condition, the dust falls into the pail and the germs carried by it find the right conditions there for developing; there may be only a comparatively small number, but these few will multiply and develop and make thousands and millions. It is matters of this kind we do not realize when milking a cow. A great many farmers say they cannot milk with dry hands. You milk with wet hands, your hands are warm and moist and the milk on them spreads over the udder, and the heat of your hands is just right for rapid reproduction of germs. You inoculate that milk, and it gradually finds its way into the pail; for that reason you ought to milk with dry and clean hands.

Cool the Milk Quickly.—The next step in getting pure milk is to put it in condition so that these germs cannot grow. I said that in growing corn we had to have certain conditions, there must be warmth and moisture, or the seed will not grow—simply lie dormant. It is the same way with the germs. If they do not have sufficient warmth they will not grow. Not one farmer in one hundred realizes what this means. Some of the best dairy men, who deliver milk in the cities, claiming to supply sanitary milk, themselves do not know what this means.

They will allow the milk to stand for a long time after milking, without cooling, and in that time the germs will multiply into thousands, and thousands into millions. One of the points that ought to be driven into the mind of every dairyman and farmer is that the more quickly that milk can be cooled the better article he is going to have. If the conditions in his barn have not been ideal (which is the case with ninety-nine per cent of the barns) he must realize that if he will take that milk and cool it immediately—let just as few minutes elapse as possible between milking and cooling—he can put it in condition that the germs cannot grow rapidly, and that, if they do not grow, the milk will remain in good condition for a long time.

There was a shipment of milk made from a farm in Illinois to Paris. This milk was neither pasteurized nor doped with preservatives. It was simply clean milk, cooled immediately after milking, and fourteen or fifteen days later it was served in the cafes in Paris, and was much better than the milk they could get there. This shows what can be done by cleanly methods of handling milk. It is all-important to every one of you. If you are shipping cream, of course, you have got to pass your milk through the separator, and I know a great many farmers who allow their milk to stand in cans without any attention for a long time after milking, when it should be separated immediately after milking. That cream is what is bringing you the money, and it needs attention. Sometimes when you have only a small quantity of cream you will set it away in a pail and pay no attention to it; it is warm, and just in condition for the germs to multiply and sour the cream. This kind of cream makes rancid butter and gives rise to "fishy" flavors and other undesirable flavors.

It is a very simple business when you understand it. When the farmer puts away his cream to cool he should put it in a can that will expose as much of the surface of the cream as possible to the cooling medium. The water that comes from our wells is the best thing to use, or ice water, if you have ice, is better. That water should be pumped fresh and kept fresh, and the cream should be stirred every few minutes, and it will soon be down to the temperature of the water and the growth of the germs will be checked. Of course, this takes a little time, and some will say they do not get any more money for doing it, but you had better do it right now, and stay right, and you will not have to learn your lessons all over.

An Important Question Is, How Often Should Cream be Delivered? That depends a great deal on whether or not the farmer follows the precautions I have been setting forth. Some farmers will neglect to cool their cream, and let it stand at eighty degrees Fahr.; then they will cool it down to fifty-five degrees F., and check the growth of the germs and go away and let it alone, and let it gradually warm up again. The temperature gradually rises, the germs, which have been checked by the cooling process, begin to grow and multiply faster than if their growth had not been checked. That is shown by experimental evidence. These experiments show that decomposition takes place with extreme rapidity and when you cool down the milk and let it gradually warm up again.

Many of us have not enough cream to ship every day. We cannot ship after every milking, but we have cream from the separator twice a day, and we have to cool this cream and keep it down to a temperature necessary for the checking of the growth of the germs. Another mistake we make—we will take fresh cream up to eighty-five degrees F. and pour it into the cold cream and warm up the whole mass, and set the germs growing again. This mass will sour very much quicker than under other conditions. After all of that cream has been cooled to the same temperature, it can all be put together with perfect safety, but when you pour the warm cream in with the cold cream it destroys all the effect of your former work. Let me impress all these things on you; you cannot be too strict in observing them.

The Cow Barn.—Another phase of the question is the surroundings for your cow—the barn you keep her in. I don't want to touch the veterinarian side of this question at all, but I say this simply from a standpoint of producing clean milk—you must have a barn well ventilated and lighted. I have been traveling all over the country and I take special notice of the different kinds of barns as seen from the train window. Most of the barns you see all over the country never present a window. They may have a little port hole of a door, but most of the time that is closed, no light whatever in the barn. I was very much pleased to see a well-built barn somewhere down the line of the Missouri Pacific road, as I was coming here. Don't know who built it, but evidently some one who understands his business—understands the need of light and ventilation. It had windows on all sides—well supplied with light and built according to the modern idea—if there is anywhere you need air and light, it is in the cow barn. It tends to keep the cows healthy, and to the production of clean milk, and the growth of bacteria is checked in such a barn, well lighted and ventilated. Darkness is essential to the growth of germs. They are killed by sunshine—there is no better or cheaper disinfectant than sunshine. You believe in putting your milking utensils out in the sunshine, don't you? Well, that sunshine is also essential in the barn. You can have it arranged so the sunshine can be shut out when necessary, and arrange it so that you can get a fresh supply of air all the time. This is essential from the health standpoint of the animal.

DISCUSSION.

Mr. Clark—What do you consider the best floor for the cow barn?

Mr. Webster—This is a most important point. I consider cement one of the best materials for floor construction. It can be washed and kept clean, and it is better from a financial standpoint, as it will last a life time; whereas, if you have a wooden floor, you have to be building a new one every four or five years. There is an objection raised by many people to the cement floor; they say it is too cold. When the cow lies down her udder comes in contact with it, the udder is highly congested with blood, and perhaps, coming in contact with the cold floor, when in this feverish condition, is not best. If you cared to you could put in a cement floor and put in a wooden frame where the cow lies down. It does not cost much to fix up the barn in this way. I am not satisfied that there is as much importance in that matter as some of our dairymen think there is.

Mr. Jones—I am just beginning in the dairy business, and want to get right at the start. I have been milking twenty cows. In regard to separating the milk, it does not seem practical to me to separate it as quickly as you suggest. I don't want to begin separating until I am through milking, because I would have to stop the separator to finish the milking; I try to do it as quickly as I can after I get through, but where you have a great many cows to milk it takes time to get around to it.

Mr. Webster—Of course, that would depend upon your circumstances as to how quickly you do it, and upon how much help you have; but it is the principle I am trying to emphasize—do it just as quickly as possible. The quicker the better the results.

Mr. Miller—Will the department at Washington furnish bulletins to those interested in dairying?

Mr. Webster—Yes; just drop a line to the Dairy Division, stating what you want in the way of information, and the bulletin will be sent to you.

Mr. Miller—Do you send a number to one person, or send to each person, when a list is sent in?

Mr. Webster—If you will send in the names and addresses, plainly written, the bulletin will be sent to each person named. We send to each person individually, because in coming direct from the department it is given a personal touch, and will be given more attention, as a rule.

Mr. Bruns—Speaking about milking with dry hands—I always brush the udder off clean and then put tallow or vaseline on my hands. Is there any injury in that? I don't like to milk with dry hands.

Mr. Webster—No. Just so the dirt don't stick to your hands and you have the udder thoroughly clean before milking.

RESOLUTIONS.

Adopted by the 16th annual meeting of the Missouri State Dairy Association..

We, the Missouri State Dairy Association, in 16th annual convention assembled, do hereby resolve:

1. That we feel deeply grateful to the Commercial Club of the City of Jefferson for its generous support and assistance, which has made

possible one of the most valuable meetings in the history of the Association.

2. That we tender our thanks to the band, orchestra and others who assisted them, for the excellent music furnished.

3. That we appreciate the presence of the gentlemen who are representing the various hand separators and supply houses, and that we recognize in them able allies in the work of developing the dairy business.

4. That we appreciate the good work done by the various newspapers in giving publicity to this meeting, and that we recognize them as a powerful factor in advancing the dairy interests of the State.

5. That we appreciate the efficient work done by the Agricultural College at Columbia, and especially the Dairy Department.

6. That we again call the attention of the Curators of the University to the urgent need of a new modern dairy barn at the Agricultural College. The present structure is entirely unsuitable for housing the valuable herd of dairy cattle now owned by the college.

7. That we commend the appointment of E. H. Webster as chief of the Dairy Division at Washington on account of his recognized ability and knowledge of the conditions and needs of the dairy interests.

8. That the Secretary of the Association be authorized to express the thanks of the dairymen of Missouri to the State Fair management for the improved facilities for dairy exhibits at the State Fair.

9. That the Association recognizes Secretary Ellis of the State Board of Agriculture as one of the best friends of the dairy interests in Missouri and fully appreciates the valuable work he is doing.

10. That the question of securing unadulterated feeding stuffs is of growing importance to the dairymen of Missouri, and that the Experiment Station should be given the same power of control and inspection over them as it now exercises over the sale of commercial fertilizers. We ask the Experiment Station to take steps towards securing this authority as soon as possible and pledge the support of the Dairy Association.

11. That we thank Gov. Folk for the interest in our welfare shown by his approving the bill providing for a dairy commissioner and hereby instruct the Secretary of the Association to send him our written word of thanks for appointing Prof. R. M. Washburn, the choice of the Association, to the office of Dairy Commissioner.

12. That we approve of the work of the Dairy Commissioner and endorse his plan of work for the future.

13. That we realize the need of a larger force of inspectors to guard the interests of the producer and consumer of dairy products.

14. That we hereby tender our thanks to the distinguished visitors from our neighboring states for the able assistance and splendid entertainment and instruction they have rendered us.

15. That we appreciate in the fullest and highest degree the very valuable services rendered by the retiring Secretary of this Association for the valuable assistance he has rendered in making this meeting a success.

16. That we recognize in our retiring President, Mr. Marple, the principal force which has led and developed our Association out of its wabbling infant condition and placed it upon the sound legs of healthy youth where it is a potent factor in the life of the State. In our inability to adequately express our deep appreciation for his invaluable services, we thank him and hope we may have his attendance and advice at many subsequent meetings.

MISSOURI.

(Hon. W. D. Vandiver, Superintendent State Insurance Department, Jefferson City, Mo.)

I am proud of the fact that I am a Missourian. I have traveled a little bit over the country. I have seen many of the other states of the Union, and they are all grand and great—there is not a place between the two oceans that a man cannot live and be happy, if he will behave himself; but I want to say in all candor, I believe there are more of the necessities of human comfort and happiness to be found between Iowa and Arkansas and between the Mississippi river and Kansas than in any other equal area beneath the shining sun.

They tell us that during the presidency of Jefferson he paid Napoleon fifteen millions of dollars for the Louisiana Purchase. Now Missouri is only one of the thirteen states and two territories carved out of that great area; and I want to tell you that, although that seems like an immense sum of money, last year alone the single State of Missouri paid into the National treasury in taxes enough money to foot the whole bill and then have a million and a half left over to celebrate the event; not only that, but Missouri last year produced enough mules to have paid the bill, and then paid the whole expense of the World's Fair besides. I am not here especially to talk for the Missouri mule, but he is a wonderful product. At his best, he stands 17 to 19 hands high, and weighs 1,900 pounds. The world has heard of the Missouri mule, and it has come to the point that no nation on earth dares go to war without first sending to Missouri for a supply of mules. His supremacy is acknowledged either in time of peace or time of war. I take off my hat to the Missouri mule and stand at a respectful distance.

Besides the Missouri mule, the hen alone could have paid the whole price of the Louisiana Purchase last year, and then paid it over again inside of six months. Not only the Missouri mule and the hen, but the Missouri hog also commands my respect, for he, too, could have paid the whole price of the Louisiana Purchase in one year, and paid it again before the year was out, and it would not have to be a good year for hogs, either.

And then the Missouri cow comes in. Talk about the dairy products! Why the Missouri cow could have paid the whole cost of the Louisiana Purchase in the butter and milk that were sold last year, to say nothing of what we ate ourselves, and to say nothing of the beef and cheese. If I knew a little more about the subject I would talk more about the cow and the products of the cow. Some people can talk best about the things they know least about, but I have to know a little something about a thing before I can talk about it. I do know, however, that when I was a boy on the farm I loved the horse and loved to take care of him, and I liked to see the cow out in the pasture, but when it came milking time I did not want to get close to her. I have always thought that whenever some fellow has genius enough to invent a machine for milking cows, I will go into the dairy business. I think I could do the churning, but the milking part I have never been fond of; but, by the way, I saw an illustration the other day of a milking process in connection with the insurance business. It was a magnificent cow—great fine specimen of the dairy herd, and she was well fed, and there was a fellow holding a large bucket to catch the milk in, and the bucket was labeled "dividends to be collected;" and the policy holder was sitting way back watching the bucket very carefully; but the fellow that was doing the milking seemed to have a yellow tube that caught the milk before it got into the bucket and passed it off into another bucket outside that was labeled "Insurance officials' private bucket." This is the insurance feature of the dairy business.

The Missouri cow commands my respect; have always been fond of good milk and butter, and if somebody gives me a good farm I'll go into the dairy business sure.

The Missouri horse also commands my admiration. There's only one thing in the world that takes my eye off a fine horse, and that's a pretty woman. Missouri has both. The records show that 26 per cent of all the registered saddle horses in the United States come from Missouri; there is only one other state in the Union that can measure up to her, and that is Kentucky. The live stock industry of Missouri in a single year is valued over $200,000,000; the grain product of Missouri is valued at another $200,000,000. The corn product of Missouri is one-tenth of the entire world's supply. In wheat, Missouri produces more than England, Ireland, Scotland and Wales all put together—produces more wheat than all the New England states, with Pennsylvania and Delaware thrown in.

Missouri is the only State in the Union that has granite enough to wall her in on all sides; iron and zinc enough to roof her in; timber enough to house her whole population for 1,000 years to come; coal and wood enough to keep them warm, and agricultural resources enough to provide them with all the necessities and most of the luxuries that can be found in the temperate zone; more, I say, of the necessities and comforts and luxuries than any other state in the Union, more of these things that stir the vitality of human effort and reward the industry of mankind than can be found in any equal area between the two oceans, or beyond the two oceans.

We have all these things, but we are not through yet. We have tunneled the mountains, covered the land with a net-work of iron rails, built cities whereIndian wigwams once stood, and turned the forests into flower gardens of beauty; but we are not through yet. I want to remind you there are 300,000 farmers in Missouri that are in the mud six months in the year. When it comes to means of transportation, a magnificent system of railroads covers our country, but the country roads are still in the mud. The next great movement that ought to be entered into by the people of our State, and of the whole country, is the building of better country roads. I have heard that in France, in Germany and in Italy the tiller of the soil can trasport his products to market at a cost of about eight cents per ton per mile, while here in Missouri, and in nearly all parts of our country, it costs the farmer 25 cents per ton per mile to get his produce to market—the difference is in the roads he has to take that freight over. I want to live to see the time when the whole United States will have as good a road system as the countries of Europe have today. We are ahead of every other country in the world in the progress of civilization, in science and literature, yet we are behind every great civilized country on the question of roads. I want to call your attention to one point in that connection—a good road is not only an advantage to the man who lives along it—a good road is an advantage to the man who lives in the city 100 miles away. A good road brings the butter and beef from the farm and dairy just that much closer to the man in the city who wants to consume these products. It is therefore unfair to expect that the man who lives on the road shall bear the entire expense of building the road.

The farmer is already taxed equally with other people, if not more heavily, and he ought not to be expected to bear the entire expense of building country roads. We would like to see a system adopted, somewhat, at least, similar to that adopted for the support of common schools, by which we could distribute the burden of taxation.

Thank the Lord, we are out of debt—we owe nobody anything but our own children—our school fund.

I would put the proposition in this way—that we will be able, in the near future, to do one of two things—either reduce the State taxes again, or apply one million dollars a year to the building of country roads, and I believe when the alternative comes, the people themselves will favor the latter. Put one million dollars a year out of the State treasury in the counties to help the plan of co-operation between the State, the county and the township, and it will not be long before we can build good roads in every county in the State.

I also believe that the National government ought to help in the proposition, too. We are building roads in the Philippines, and even in Cuba and Porto Rico. I want to say that I believe that if the National government would spend one-half the money, distributing it among the people, on this co-operative plan for the purpose of assisting in the building of roads, that they are now spending in enterprises thousands of miles away from home, not only our own State, but the whole country, would reap a benefit never known before in the history of the country. Last winter during my last term in Congress I tried to introduce a bill making an appropriation of eight million dollars for country roads. Of course, they would not pass it, said it was not germain.

This is not a political question. I believe the first bill for an appropriation for roads that was introduced into Congress three years ago was introduced by a Republican, and the next by a Democrat; both parties are divided on the subject. I would like to see every Missouri farmer put the proposition up to his Congressman, whether Republican or Democrat, and ask him how he is going to vote on that proposition.

I guess I have taken up enough of your time. I always like to talk about Missouri. I could say much more, but this is enough, and I thank you for the kind attention you have given me.

ADDRESS OF MR. D. J. CLIFFORD, ASSISTANT DAIRY COMMISSIONER.

(Delivered before the State Dairy Convention, Jefferson City, Nov. 15-17, 1905.)

Mr. President, Members of the State Dairy Association, Ladies and Gentlemen:

It is with much trepidation that I attempt to address you in the closing hours of this convention, as I feel not only a natural diffidence but a lack of ability to fully compensate you for the time that I may occupy in my brief remarks.

After listening attentively and instructively to the eloquent and exceedingly felicitous remarks of the distinguished corps of lecturers who have honored us with their presence, from the various states in the Union, supplemented by the magnificent address of Hon. W. D. Vandiver, on "Missouri," it would be a travesty on your patience and an unwarranted presumption on my part to further inflict you with any humble efforts of mine. Nevertheless, I would be derelict to every sense of honor, propriety and the ethics of comradeship were I to remain silent.

This meeting has been to me unquestionably one of the greatest events of my life. For three days I have attended every session of the Association, and noted with carefulness and precision the various points of interest, touching upon dairy economy, by eminent authorities from many states. These papers evidenced great depth and exactness of research, forethought and large experience along the lines of this special industry. I was surprised that our worthy chairman, who manages and has the exclusive control of one of the largest individual creameries in the world, could take charge and draw into requisition so many experts. This program has been filled from beginning to end without the elimination of a single number.

Notwithstanding the wonderful fertility of our soil, the salubrity of our climate, the abundance of pure water and the millions of acres of unused soil producing succulent grasses, especially adapted for dairy feeding, we have been a laggard in the march of progress in the development of dairy enterprise. I will state a few of the reasons that have conduced to this result. It proceeds from the fact that the Missouri farmer has devoted most of his time to the raising of live stock and the production of cereals, and only recently he has begun to see the value of the dairy industry. It is only within the last decade that the meetings of farmers' institutes have been largely attended. I am pleased to note that scientific farming is now an accomplished fact throughout the length and breadth of this commonwealth. Inquiries are daily being made through the Secretary of Agriculture for bulletins and other information of value to the farmer. I fully realize that the struggle will not be an easy one, and the State Board of Agriculture, through its executive officers and the State Dairy Commission, are lending every energy to the farmers in the encouragement of this line of activity. There is no rose bush without its thorns; no day without the approach of evening shades; no life without the menace of death; no compensation without great labor, and it will require assiduous effort, intelligent direction and unflagging zeal to bring about the most beneficent results.

I have been a close student of conditions for the past two decades, at least, having read the current newspapers and magazines, and the best thought of the age, and I want to say to you that I have never witnessed anything that equals the Missourian when once aroused; he is patient, yet intelligent and aggressive. We have passed through a long period of darkness, but the Venus-like god of peace beckons on the morning of our glorious deliverance into a new empire of industrial activity, with its accompanying reward.

At this epoch in our history, when every fiber of our commercial being, as well as agricultural life, is thrilling with vivifying force, it is fortunate that the affairs of State are in such excellent hands. At the other end of the capitol, we have as our chief executive a modest, unassuming gentleman, who is actuated by the spirit of the highest patriotism, and whose love for Missouri partakes of an almost idolatrous nature. In the selection of his appointees, he has been actuated solely for the betterment of conditions, and no man whose private character is not above reproach, is called to fill any responsible position. It has been my pleasure, and I consider it a distinguished privilege, to have discussed with him, at various times, the possibilities of dairying in this State, and he has assured me on every ocasion that he will lend every energy within his power to help us in bringing about the most successful results.

As the paling tinges of age accumulate, we observe a tendency to recall the memory of flowers that bloom from the stem of youthful incident and association, and those of the most brilliant hue and fragrant perfume were culled along the path that many of the persons present trod together. Later years lack the vitalizing power of unselfish sympathy and fellow feeling, and we unconsciously turn to the bubbling springs that trickled with the gems of by-gone days.

I have listened with unabated interest to the tales related by the early pioneers, telling of the stirring episodes of the past, and I was filled with interest to see the fires of enthusiasm burn as brightly now among this rugged and worthy class as actuated them in the early days of their activity. You are going to be rewarded for the courage and energy you have displayed during the past sixteen years in Missouri in following up and advocating the cause of dairy industry. I am studying the thing closely, and I must say you have admirable men in Missouri; authorities on the question, devoting their lives and energies to this cause, giving time to this movement that practically should be devoted to something else, but they see a future in it.

Among the many eminent gentlemen who have contributed their time, energy and best effort to the cause I wish to include Honorable George B. Ellis, Secretary State Board of Agriculture. A distinguished authority and man of national reputation recently told me that Mr. Ellis is unquestionably the ablest man and best authority on this subject of any secretary connected with any State Department in the United States. A practical farmer, with four years' service in the State Legislature, and a number of years in his present position, he is fortified and willing to be of great assistance to us in the future.

As Dairy Commissioner for Missouri we have a man of practical and scientific knowledge; a man whose ability has been commended on this floor by the Dairy Commissioners of Illinois, Iowa, Wisconsin and Minnesota, who all know him personally, having worked with him, and his work is known in the Department of Agriculture in Washington, where his observations have been accepted.

Governor Folk has been exceedingly fortunate in selecting such an excellent man for this place.

I wish to state to the dairy men of Missouri that if they have any legislation which they wish to formulate for the development of this business, put it in shape and send to Professor Washburn or myself, and we will endeavor to co-operate with them in bringing about better results, and I feel assured that our Governor will make recommendations that will advance the cause of dairying in Missouri.

Since the induction of Governor Folk into office the foot-fall of the lobbyist has been as echoless upon the capitol floor as the resounding tread of Caesar's tenth legion. I trust that each member of this Association, when he returns to his home, will consider the subject discussed seriously, and communicate with our Commission any facts he may glean or absorb relative to the betterment of conditions.

As fruit ripens in the autumn time, I trust with each recurring anniversary of our meeting our recollections will grow more mellow.

I thank you for your patient hearing.

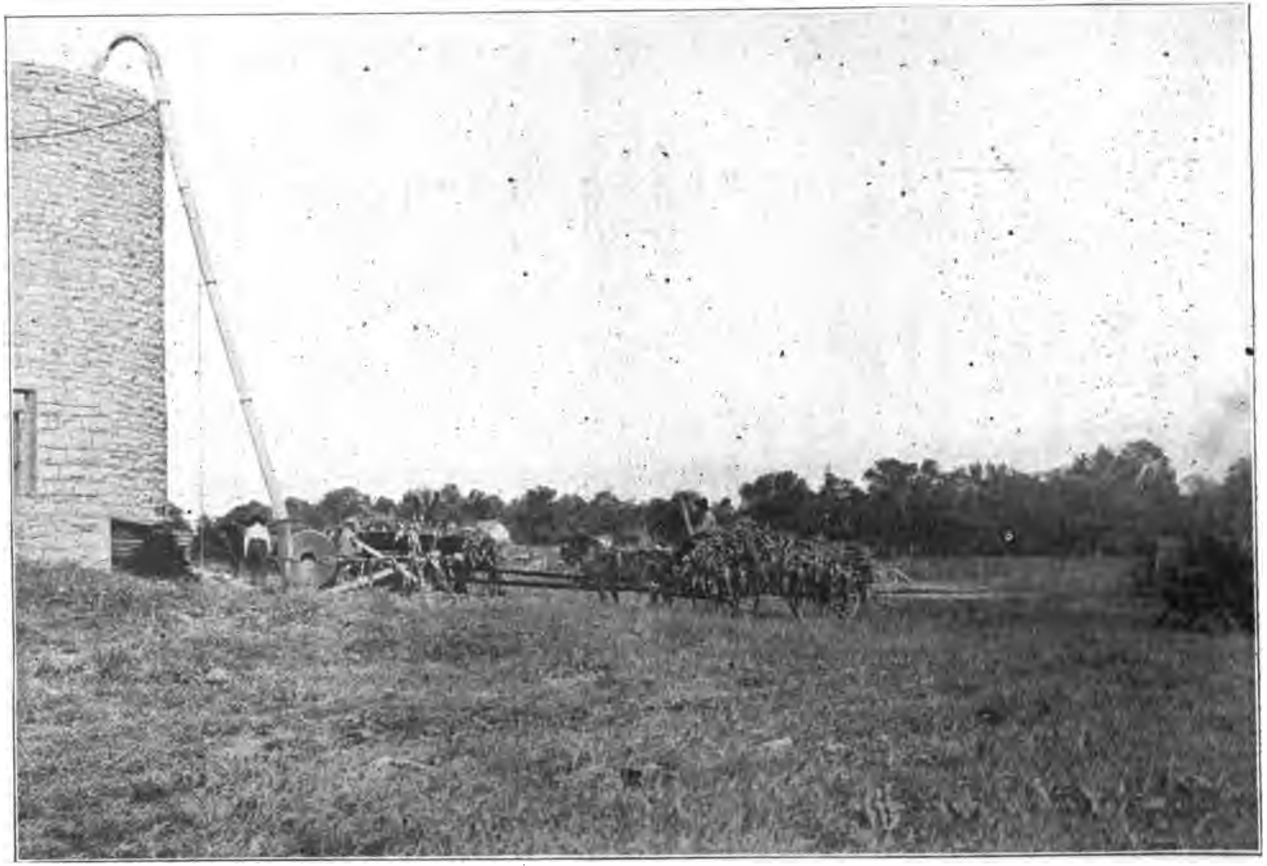


Figure 1. New stone silo on State Farm, Columbia, Mo.

THE SILO, ITS USES AND HOW TO BUILD IT.

(By R. M. Washburn, State Dairy Commissoner.)

It is not given that one man shall have all the useful experience. Every man of deeds has experiences peculiar to his work and valuable to all men in his line of work. Let us then add to our knowledge from the experience of our neighbor, respecting his experience as we would ask that he respect our soundly learned lessons. In these days of books and papers, one man's success or failure may prove a blessing to thousands. Let us, then, live in the present and improve our every opportunity to learn.

ADVANTAGES OF THE SILO.

1. Silage keeps young stock thrifty and growing all winter.
2. It produces fat beef more cheaply than does dry feed.
3. It enables cows to produce milk and butter more economically.
4. Silage is more conveniently handled than dry fodder.
5. The silo prevents waste of corn stalks, which contain about one-third the food value of the entire crop.
6. There are no aggravating corn stalks in the manure when silage is fed.
7. The silo will make palatable food of stuff that would not otherwise be eaten.
8. It enables a larger number of animals to be maintained on a given number of acres.
9. It enables the farmer to preserve food which matures at a rainy time of the year, when drying would be next to impossible.
10. In the south, where the rainy season destroys the exposed fodder, the silo will be found invaluable.

HISTORY OF THE SILO.

In Europe the silo has been known for hundreds of years. Ancient writers tell us of the practice of burying grain and green food in underground pits to preserve them from their enemies or against a poor year. These pits were ten to twelve feet deep, and often as wide, with bottom and sides made tight by plastering with clay. All manner of green foods were preserved in these pits by pressing well and covering with earth. Foods thus treated would remain succulent and palatable for a year or more.

Probably because of the labor attached to this method it had almost ceased to be practiced, when M. Reihlen of Stuttgart, Germany, in the middle of the nineteenth century, revived the practice among his people. The greatest boom that the silo has probably ever had was started by a French farmer, Auguste Goffart, who, in 1877, published a little book, giving the result of his 25 years of experience and observation in the matter of ensiling green foods. In 1875 the Department of Agriculture at Washington began to investigate the matter and published its findings.

It is claimed that the first silo built in the United States was put up by Mr. F. Morris of Maryland in 1876. From that time on, the silo grew in favor with great rapidity. In England, in 1882, there were 6 silos; in 1884, 600; in 1886, 1,605, and in 1887, 2,694. No later statistics are available. The English farmers, as a class, are more conservative than their American cousins; therefore, it is probably not unsafe to say that the growth in number of silos in this country has been fully as rapid as in England. The increase in this country is probably

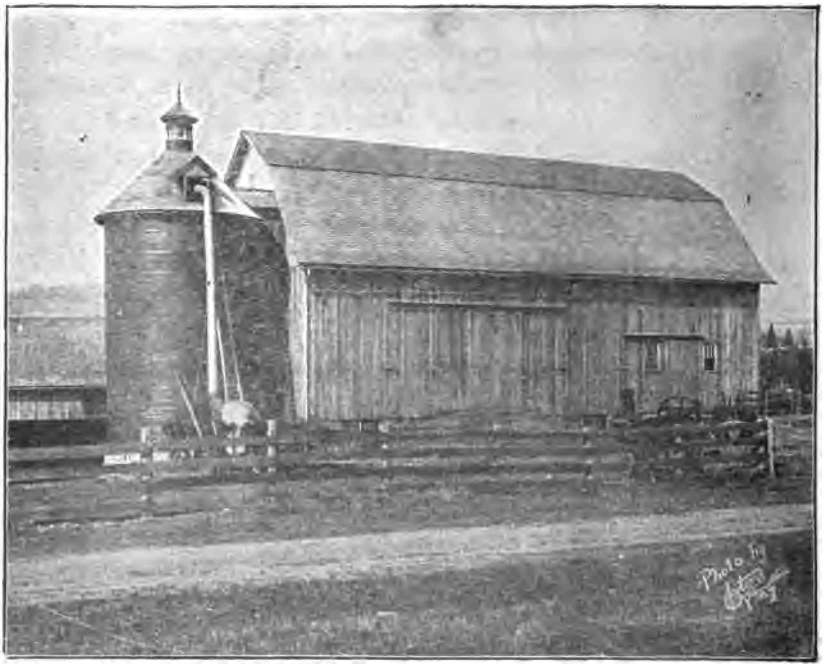


Figure 2. At the end of the barn is frequently the most convenient place for a silo. Note how close the cutter with blower stands to the silo.

(Courtesy Silver Mfg. Co.)

more rapid now than at any previous time. This growth is a natural one, the result of true worth. The progress in the past has been interfered with to some extent by the extravagant claims of some overly enthusiastic writers. Now, that more is known of the silo, enough can be said without exaggerating. The silo in America will some day be as common as the cow stable.

WHERE TO PLACE THE SILO.

In former years the silo was placed inside the barn, but because of the odor that is constantly present with the silo it is now placed outside, but close, within two or three feet, to the side of the stable, best at the end of the main feeding alley. A door is cut through the wall at this point and the stable floor extended to fit against the silo. A cheap chute of boards is then built from the top of the silo to this extended floor. Silage thrown into this chute will drop into the basket or cart at the bottom, and will then be in the feeding alley, where wanted. When done feeding, the scatterings should be cleaned up and the door closed, to prevent a silage atmosphere in the stable. The outside silo usually has the advantage also of being easier to fill.

FORM TO BUILD.

At first silos were made square or rectangular, because easier of construction, but it was soon found that it was next to impossible to prevent the silage in the corners, and along the sides, from spoiling. It did not settle evenly or firmly. Some old silos made with corners have been improved by cutting off the corners with concrete. A form was made of bent wood, which was tacked to the walls each side of the corner, and concrete was slushed behind it. When this hardened the form was brought up to its width and the process continued. At this day there would be no excuse for building a silo with corners. A cyclindrical silo causes no waste and will contain more silage for the amount of material used in building than a square one.

SIZE TO BUILD.

The larger the silo the cheaper it will be per ton capacity, but if too large for the number of stock to be fed, there will be a cntinual waste from decay. Silage exposed to the air, in warm weather, will spoil in 2 or 3 days, so stock will not eat it. When once the silo is opened it should be fed from continuously until empty. Build the silo small enough, so that the animals fed will consume a quantity of silage each day equal to a layer about two inches thick over the entire surface of the silage. Silage keeps better in a deep silo than in a shallow one, because more firmly packed. More feed can also be stored in a given space. Mr. A. J. Glover, formerly of the Illinois Agricultural College, now with "Hoard's Dairyman," recommends the following:

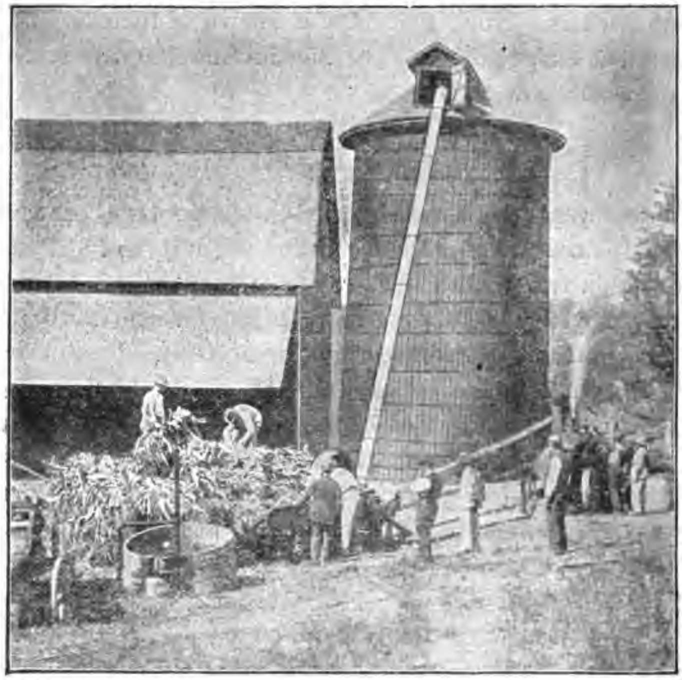


Figure 8. A stave silo being filled with the blower.
(Courtesy Silver Mfg. Co.)

No. of animals to be fed from silo for 200 days.	Inside diameter feet.	Height feet.	No. acres corn.	Approximate capacity in tons.
20 to 25	14	28	8 to 9	100
25 to 30	15	30	9 to 10	115
30 to 35	16	32	11 to 12	145
35 to 40	17	34	12 to 14	175
40 to 45	18	36	15 to 17	200
50 to 60	19	38	18 to 20	250
60 to 70	20	40	23 to 25	300

"A silo should never be built over 20 feet in diameter. If it is necessary to have more material to feed it is better to build two small receptacles than one larger than 20 feet in diameter. It involves considerably more labor to handle silage in a very large structure than in one of reasonable size. Many farmers prefer to have two silos. They feed from one during the winter, and have the contents of the other for mid-summer's feeding."

CONSTRUCTION OF SILOS.

Essential Features.—It does not matter what material the silo is made of; it must be *air tight* on sides and at bottom. Any crack or knot hole or poor joint at the door will admit air, and the silage will rot just in proportion to the amount of air that enters. The receptacle must be strong enough to withstand the lateral pressure of the silage when it settles. This lateral pressure at 10 feet from the top is 110 pounds per square foot, at 20 feet 220 pounds, and at 30 feet, 330 pounds, and at 40 feet, 440 pounds. It is very difficult to make deep rectangular silos whose walls will not spring enough to allow air to circulate up and down the sides and cause losses.

Depth of the Silo.—This should be made as great as practical, because, 1st, in this way the largest amount of food per cubic foot of space may be stored; and, 2nd, the silage keeps better because packed so solid; and, 3rd, there is less relative loss at the surface. The top of the silage always spoils to a depth of 2 to 8 inches. No silo should be less than 25 feet deep. A silo 20x40 will hold twice as much as one 20x25, and one 36 feet deep will hold 5 times as much as one 12 feet deep.

Summer silos should be deeper in proportion than those intended for winter use, because the silage spoils faster in summer and must be fed down at the rate of about three inches a day to have always fresh silage.

Foundation.—This must start on level, firm earth, and should extend about 2 feet above the surface of the ground. If the foundation is started deep the hole should be dug large enough to give ample room outside of the wall to thoroughly tamp the earth up close to the foundation. There is a tremendous outward pressure against this wall, especially in deep silos, and if it is not made strong it will crack and admit air. It is also well to build into the wall, about 18 inches above the surface of the ground, several heavy wires to keep the wall from cracking. It should be made of stone or brick, laid in cement mortar, or of concrete, and from 12 to 18 inches thick, depending on the height the silo is to extend above it.

Placed Partly in Ground.—It is a good plan to dig down 4 or 5 feet in order to secure good, firm earth on which to start the foundation, and also in order to get the greatest capacity in the silo without going too high into the air. Deeper than five feet would not be either convenient or safe.

Drainage.—Care must be taken in wet places not to dig down much, or else the soil must be drained. In many places even a good wall of stone, laid in cement, and well plastered inside with cement, will not keep the soil water out. In some parts of the south the houses can have no cellars on this account.

Protection Against Frost.—It does not injure silage to freeze. Even if the heat of the silage itself should not prevent the portion close to the wall from freezing, that portion may be piled up by itself on the silage and fed as soon as it does thaw out.

Floor.—On sandy soil a floor will be needed to keep out soil air, but on clay land there need be no floor unless rats and mice trouble, then a cement floor may be laid.

Roof.—In the southern portion of this State and south no roof is needed. Farther north, where a snow fall may be counted on a cheap roof will be found convenient, not that the snow would injure the silage, but that it would mix with it and be in the way when fed.

Painting of Wood Silos.—A coat of paint or tar on the inside of a wood silo does not prevent the silage juice getting into the wood, but does retard it drying out when the silo is empty, and thus hastens decay. The outside may be painted and the inside washed with a wood preservative, something that will not hold the water and will destroy the mould plant in the wood.

Cement Work.—Every farmer who makes farm conveniences, such as stable floors, fence posts, silos, etc., of cement (and this should include practically all farmers) should send to the United States Department of Agriculture, Washington, D. C., and ask for farmers' bulletin No. 235, on "Cement Mortar and Concrete, Preparation and Use for Farm Purposes." It gives in plain language the kind of material, proportions to use, and how to proceed to make everything needed in cement on the farm.

THE KIND OF SILO TO BUILD.

This will depend very much on the cost of lumber, stone, sand and gravel in the particular neighborhood and on the farmers' ability to build permanently, even though it does cost somewhat more at the start.

On a permanent stock farm, where the farmer has means to build well, there is no doubt that the stone, concrete or cement block silo would prove the most economical, but where there is limited means, and on farms that are rented for a short term of years, the all-wood stave or the wood frame cement lined silo would be more profitable.

STONE SILO.

When stone is cheap and a long-lived silo the object, the stone silo may be the most economical.

That portion of the stone work which lies below the surface of the earth should be laid in cement rather than lime mortar. Lime sets very slowly under ground. "After the wall is 2 feet above ground a good lime mortar may be used, but in this case there ought to be at least two months for the wall to season and set before filling."

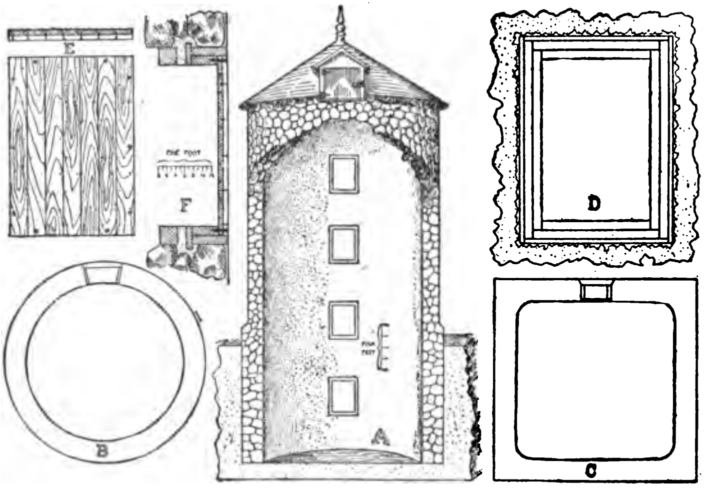


Figure 4. Shows construction of stone silo. The basement "A" is a little too deep, for any but bank barns. "B" shows a cross-section of the silo. "C" and "D" the door way. "E" the door in side view and end view. "F" the door in place.
(After King.)

The wall at the bottom should be 18 inches in thickness and at top 12 or ten inches, the narrowing being made on the outside, the diameter inside being kept the same all the way up. See figure 4.

The Missouri Experiment Station built a stone silo in the summer of 1905. It is 20 feet in diameter and 40 feet high, holds about 275 tons. The wall is 18 inches in thickness, laid up in lime mortar. Above and below the five openings in the silo one-half inch iron rods are built into the wall in the form of hoops to keep it from springing or cracking. The inside is plastered smooth with Portland cement mortar. For the construction of this silo there were required, approximately, 120 perch of stone. The average cost of labor in construction was $3.50 a perch. The first cost seems great, but with an occasional whitewashing with cement inside to fill the small checks, it ought to last a hundred years. This is the silo referred to as having had no roof during the fall rains. See figure 1.

The Doors.—Doors for feeding should be arranged as in figure 4. The door frames should be made of 4x6 stuff, matched together at corners. A 1x4 board may be firmly nailed on the inside of this frame to form a jamb for the door to fit against. To make the door fit air tight, tack felt on the edge of this jamb. Arrange to have the door flush with inside wall of the silo and have stones projecting into the doorway enough to hold the pressure of the silage against the door. Make the 4x6 door frames 20 by 30 inches inside, then make the door of two thichnesses of matched flooring, running in opposite directions and all screwed firmly together and to two firm 1x4 cross pieces, which are on the outside. Through the center of the door, projecting outward, put a ⅝ bolt, 10 inches long. This should have a large washer on the inside. This bolt is to put through a 3x4 cross piece to draw the door up snug to the jamb. The silage above will not press it snug enough and it is unwise to nail it. This makes an exceptionally good structure, though one of rather great first cost.

CEMENT BLOCK SILO.

Cement is getting to take the place of stone in most lines of construction. There are a few cement block silos in this State. Mr. J. O. Bailey, Kirksville, Adair county, Mo., has one 16 by 32 feet, of which he says:

"I made the blocks myself—size 8 by 8 by 24 inches, curved enough so that 25 of them would lay a complete circle, 16 feet in diameter in the clear. Proportioned the cement and sand 1 to 5, *i. e.*, 1 part cement to 5 parts sand. It took about 50 yards of sand and 205 sacks of cement. I also laid a No. 9 wire between each layer of blocks up twenty feet. I don't think now it is really necessary to use the wire.

"I had a mason to superintend making of the blocks, but any one with average intelligence can make the blocks as good as a mason. The main thing is to get sand and cement thoroughly mixed. It does not want to be too wet, just moist enough to pack good in the mold. After the blocks have been made half a day or so they should be wet every day; this keeps them from drying too fast and from cracking.

"I hired a mason to lay up the blocks; this is the only skillful work about it, they have got to be laid up true. I did not cement inside of silo. My silage spoiled some around the outside. This is due to lack of moisture in the silage and also in the wall. I should have wet the silage and wall as the silo was filled, but was not fixed to do this.

"My silo is built 3½ feet below the surface and in the last 4 or 5 feet of silage there was not a forkful spoiled.

"Two men can make 90 to 100 blocks a day after they become accustomed to it. I used a wood mold which any carpenter can make and will not cost over $1 or $1.50, at most.

"Now as to the doors. I used 2x6 plank for the jambs and set them flush with the outside of the wall; as the blocks are 8 inches thick there are two inches on inside for door to set in. The doors are ship-lap doubled with a good quality of tar paper in between, also a layer of tar paper on the side that sets against the jamb. The doors are 2 feet square and every 4 feet. Total cost about $225.00. The cost for labor to fill it I estimate at $50.00."

This is a cost of nearly $2.00 per ton capacity, but inasmuch as it will last a great many years it may be the cheapest kind in the long run. See figures 5 and 6 for block silo and form of a block.

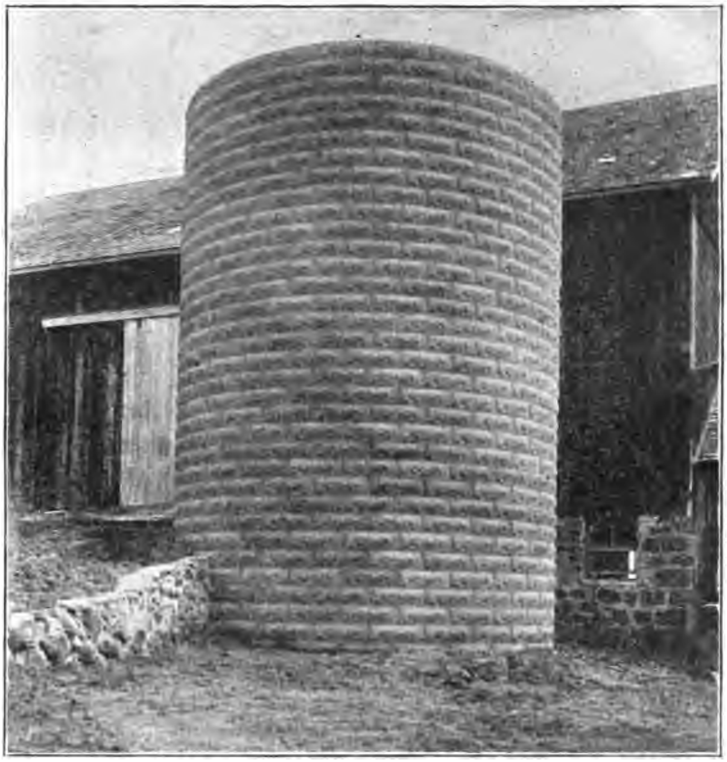


Figure 5. Cement block silo. The kind built by Mr. Dunlap of Center, Ralls county. (Courtesy Hoard's Dairyman.)

Mr. Alfred S. Dunlap, Centre, Ralls county, Mo., has a cement block silo 16 by 32 feet inside, extends 18 inches in the ground. He says, "The blocks are 6x6 inches by 2 feet long. Used 200 sacks of Portland or Atlas Brand cement in the foundation and blocks. 1,400 blocks were required to build it. Just what the cost was I do not know, as my farm help worked at making the blocks, commencing in the spring and working at odd times. It, perhaps, cost $275.00, but I did not haul my sand and gravel more than a 100 rods. I used a No. 14 cutter and a 10 horse-power traction engine, and did the work of cutting to my entire satisfaction. We worked three days and filled it about two-thirds full, and filled with corn grown on bottom land and very heavy."

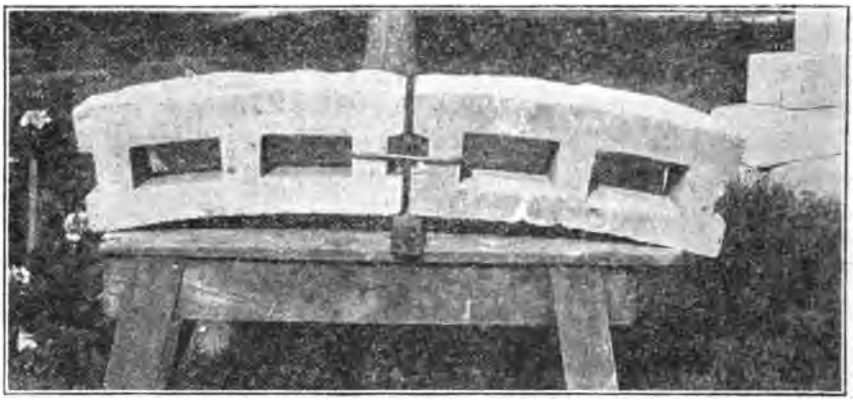


Figure 6. Form of block used in the silo. Note the manner of reinforcing the blocks by means of ⅝ iron binders. The hollow blocks require less material than the solid ones, and will not freeze so readily.

(Courtesy Hoard's Dairyman.)

Mr. Dunlap here touches a very important point. He got his material in the spring and had his men work at block making when they could do little else, thus saving much valuable time. Mr. Dunlap also mentions having a loss of silage close to the wall because, as he says, he did not cement up the inside after the blocks were laid up. The inside should be well cemented to close all pores possible, then, when the fodder is cut in, water in plenty should be used, especially around the edges next to the walls.

CONCRETE SILO.

Silos are getting to be made of concrete, slushed and tamped into a solid structure by means of forms. The only one in this State known to the writer is that of Mr. C. J. W. Jones, Roanoke, Howard county, Mo. This silo was built in the summer of 1905. It is 16 by 40 feet inside measurement, it being 9 feet in the ground. He first dug the hole and leveled the bottom. Then started the inside form, which was made of old pieces of fence boards, stood on end around the circle and held in place by thin limber boards tacked onto them. He also had a center pole to guide by and brace to. The bottom wall was made thick and tamped against the earth bank. When the level of the ground was reached he carefully leveled up the work and started the outside form, which was made of a band of iron, 20 inches wide and 53.43 feet long, rolled to form the circle and was fastened with clamps at the ends. The silo being 16 feet in diameter and the walls 6 inches thick, the form is then 17 feet in diameter. This was leveled and the space between it and the inner wall of boards filled with concrete and tamped. When this hardened the form was loosened, raised and screwed tight again after getting it level; the space again filled and so on to the top. The inner wall was raised as needed, being braced against the center pole from all sides.

See figure 7. Notice at the top of the silo the iron form still stands surrounding the wall it last built.

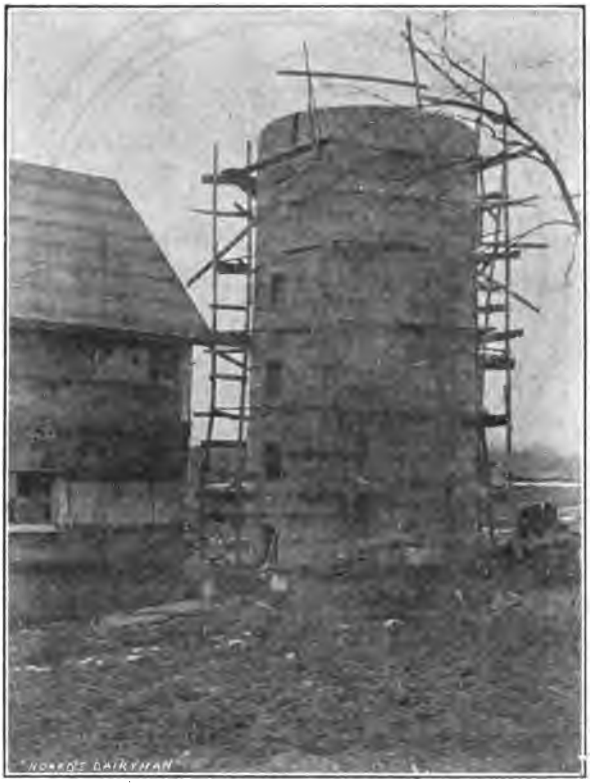


Figure 7. Concrete silo of Mr. C. J. W. Jones, Roanoke, Mo. Made by Mr. Jones and his son.

(Courtesy Hoard's Dairyman.)

Every few feet a wire rope made of four strands of No. 9 wire, twisted, was built into the wall to prevent cracking. Iron rods, bent to the circle with hooks on the end, as shown in figure 8 are sometimes used in concrete and stone walls.

To build this there was required about 40 cubic yards broken stone, 20 of sand and 50 barrels of cement. Mr. Jones and his son did the work when they could steal the time from farm work. It would be difficult to say how much time was used in the making, but there is one thing sure, there is a silo that will not dry up and open cracks, nor blow down with anything less than a cyclone, and will doubtless last two or three generations. Material cost about $150.00. Doors were made by building the frames into the wall while making. The frames are of 2x6 stuff, made and set same as described under stone silo.

Roof.—No roof is provided; nor by Mr. Jones deemed necessary. It is only a convenience in bad weather.

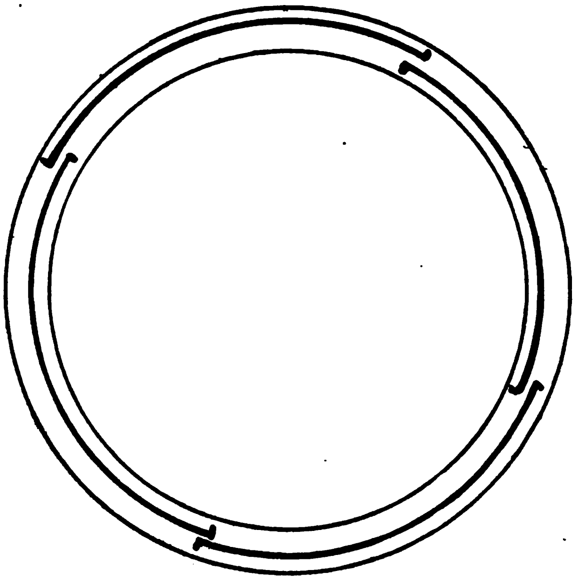


Figure 8. Showing manner of putting iron rods turned at the ends into stone, brick or cement foundation. The heavy lines inside are the iron hoops.

(After King.)

CEMENT LINED SILO.

This is a modification of the old all-wood silo, and is known as the Gurler silo, because Mr. Gurler of Illinois brought it into prominence.

Material Needed.—For a silo of this kind, 14 by 28 feet, (about 90 tons if filled full), there will be needed, for the foundation, if 12 inches thick and 3 feet high (one foot below ground and two above), 500 brick and 650 pounds cement and two-third yards of sand;

or 6 perch of stone and 450 pounds of cement and ½ yards sand; or 3 yards gravel or crushed rock and 1,500 pounds of cement and one and two-third yards of sand. Mix the cement mortar 1 part cement to 3 parts sand; for concrete use 1 cement, 3 sand and 6 gravel or crushed rock—the crushed rock is stronger than the gravel. Imbed in the wall a rope made of 4 strands of No. 9 wire, twisted, or, if more convenient, two or three circles of old barb wire. This would go well in the concrete wall. For the plaster there will be needed about 5,000 pounds cement and 4 yards of clean sand. The plaster is put on about half an inch thick.

For the superstructure, not including the roof, there will be needed 55 pieces, 2x4, 14 feet long, and 44 pieces 16 feet long. These are for studs, sill and plate. For sheeting, one-half inch thick and 4 inches wide, about 1,600 feet unmatched. Lath needed, 52 bundles plain house lath or its equivalent of beveled lath made of 3-inch batting, ripped and corners on one side taken off. The University of Illinois reports excellent success with common house lath nailed flat against the sheeting

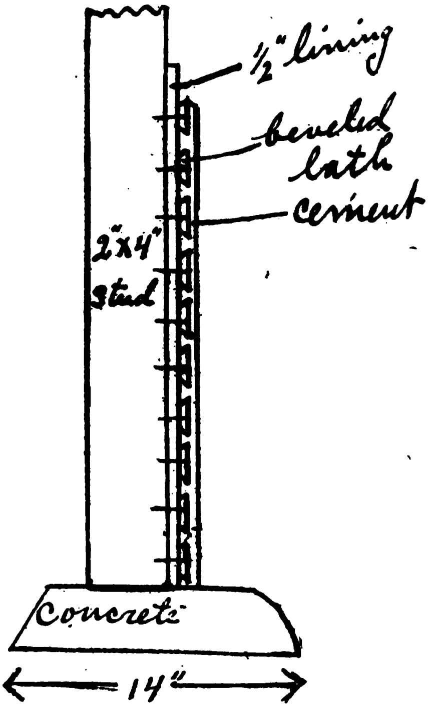


Figure 9. A cut showing construction of the cement-lined silo. Onto the 2x4 stud is nailed the half-inch lining, and onto that the beveled lath, then the whole thing is plastered with cement mortar.

without any furring. . It is still considered better to use the beveled. See figure 9. About 150 pounds of nails will be needed. For the four doors about 34 feet of matched flooring.

To Build.—On top of foundation made level place 2x4s cut two feet long to form sill. Bed them in cement. Upon this sill stand 2x4 studs, 1 foot apart, a 16-foot and a 14-foot lapped two feet and well spiked. Toe-nail these to the sill and brace well to keep perfectly plumb. Sheet up to the bottom of the first door, about two feet, put in the door frame made same as described for stone silo except of 2x4 stuff. Continue sheeting up to next door and again put in the frame. Continue to the top, always fitting the sheeting well up to the frames and nailing snug to the studs. Now put on the plate made of 2x4 stuff cut two feet long and spiked on top of the studs. Put on a second layer of these pieces, breaking joints with the first. Onto this sheeting nail the lath securely and horizontally and plaster the whole wall about half an inch thick with cement mortar. The foundation wall, both inside and outside, should be beveled to run the water away from the wood portion.

Hoops.—At two feet, six feet and ten feet from the foundation it would be wise to put hoops made of the half inch sheeting stuff nailed firmly to the studs around the silo. The lower one would best be made three thicknesses; the others, two.

A roof may or may not be put on. The outside may be covered, but there will be no loss of either quality or quantity of silage if it is not sheet iron painted on both sides makes a very good cover, though stove pipe iron is cheaper.

The dairy department of the Missouri Experiment Station built a silo of this kind in the summer of 1904. The work was done by the farm and stable hands at odd times. It would be difficult to say how much the work cost. The material cost about $150.00, including the shingled roof and the stove pipe iron covering. There should be an open space at bottom and at top of this outer covering to allow a circulation of air to prevent the wood from rotting. Freezing will not injure the cement lining, but if the silo is not protected the wind may spring it enough to crack the cement a little, making it best to whitewash with a cement wash occasionally. Mr. H. B. Gurler of DeKalb, Illinois, has six silos of this make, three of which have been in use for 9 years and are still in excellent condition.

WOOD-LINED SILO.

This silo is built like the previous one, except that in place of the lath and plaster, tar paper and a second sheeting of half inch boards (this time matched and smooth inside) are used. This makes a very good silo as long as it lasts, but the wood cannot dry readily between these layers, rot sets in and in a few years a new lining is needed. This kind was built largely some years ago, but is not to be recommended on account of its short life, unless the silo is to be built under peculiar local conditions. Fig. No. 10 shows method of placing sheeting and paper The inside layer of boards and the second layer of paper are not needed in Missouri, neither is the outside boarding essential.

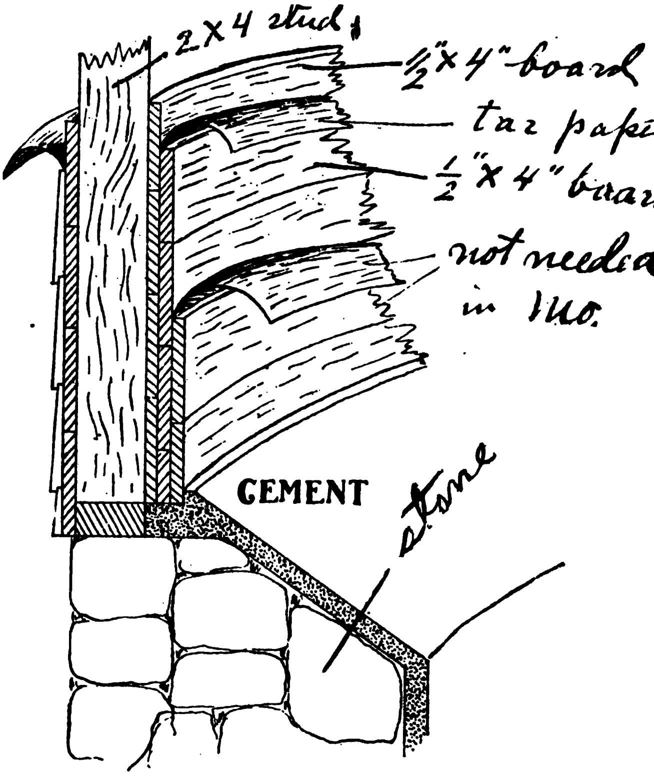


Figure 10. Wood-lined silo. The second paper and the third sheeting are not needed in Missouri. The outer covering is good, but rather too expensive.

(After King.)

Mr. H. C. Goodrich, Calhoun, Henry county, Mo., and Mr. James Elliot, Windsor, Henry county, Mo., have silos made in this manner. They report good silage and satisfaction thus far, but in 10 or 12 years from time of building a new lining will likely be required.

STAVE SILOS. (READY MADE.)

The demand for silos is so great that there are now on the market several makes of ready-made stave silos. These are merely immense, straight-sided barrels, well hooped to hold the pressure. These being of single thickness, dry out well and will last much longer than the double-layer home-made kind. These ready-made silos may cost somewhat more (first cost) than one of equal size built at home, but the writer has found them to be very satisfactory on account of the fact that all joints fit so well that there is practically no waste from spoiling. The silo, though cheap at first, that is not tight and causes a continual loss of 3 or 5 per cent of the silage made, may, after all, be expensive. These come knocked down, with full directions as to how to proceed to set them up. It is always well to follow the advice of the manufacturer in such matters. Prices can be gotten from the dealers on request.

Mr. Jesse Williams, Excelsior Springs, Clay county, Mo., has a ready-made silo, of which he says: "The * * * silo, 16x30 feet, with six-foot concrete basement, is entirely satisfactory in construction. We put in about 20 acres of corn, which kept perfectly. We have fed about 45 head, ten calves, and the rest grown stock, for two and one-half months, and have fed about one-third of the ensilage. The * * * ensilage cutter which I purchased at the same time is also satisfactory. We tried it to its full capacity and it never choked."

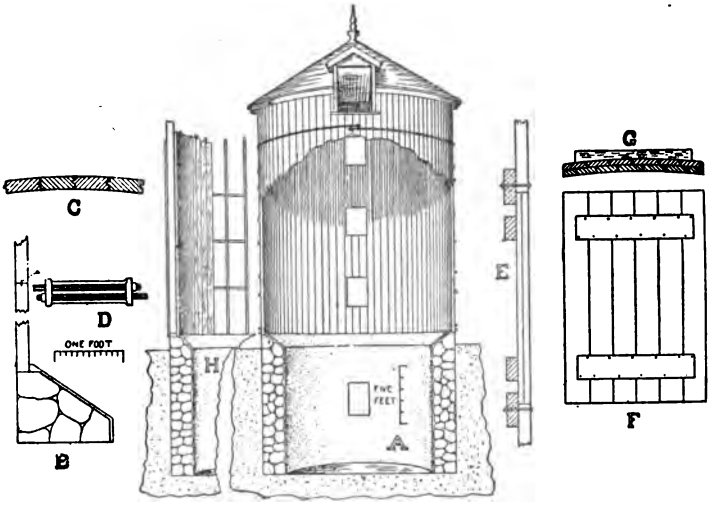


Figure 11. Stave silo, showing construction. "A," deep basement; "B," stone foundation top, showing silo set flush with outside of the wall; "C," cross-section of 4 staves, showing tongue and groove; "E," door fitted in place; "F," the door; "G," cross-section of the door.

(After King.)

Mr. Fritz Sensor, Corder, Mo., has one of these stave silos, and is pleased with it.

STAVE SILO (HOME MADE).

This "Buff Jersey" silo is becoming popular because of its low, first cost, solidity when up, ease of construction and length of life. While it will not last like stone or cement, it will last until it has paid for itself many times over.

Foundation.—Make the foundation same as for the cement-lined or the ready-made stave, except make the sill of 2 by 6 stuff instead of 2 by 4.

Material.—For a silo 14 by 28 feet, plain straight pine 2 by 4, free from knots and wain edges needed, 132 pieces 12 feet long, 132 pieces 16 feet long and 4 pieces of 4 by 6, 28 feet long, 40 pieces five-eighths round iron, 12 feet long, with threads cut a foot on each end. Each rod should be supplied with 2 large washers and 2 nuts. Nails and 6-inch spikes in plenty.

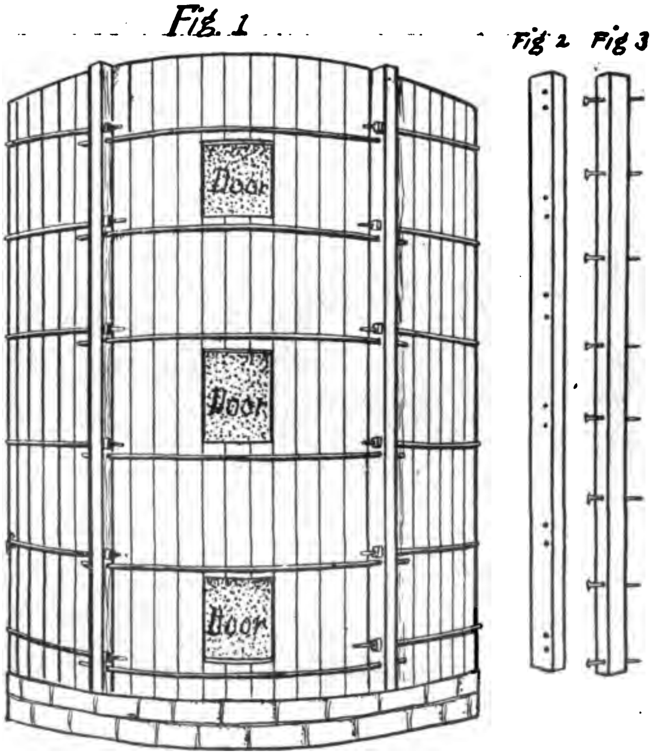


Figure 12. Figure 1 shows Buff Jersey silo complete. The method of placing doors is shown, and also the hoops and the way they pass through the 4x6-inch timber elsewhere described. Figure 2 shows one of these 4x6-inch pieces with holes bored ready to be placed in position. Figure 3 shows one of the 2x4 pieces with spikes passing through it as they do in constructing the walls. Some parties have reported that they have built their silos with the 2x4's flatway, making walls four inches thick. They used 12d nails.

The 4 by 6 are to form the "corners" of the round silo and also act as lugs for the hoops to go through and draw against, as shown in figure 12. Bore holes through these posts through their 6-inch dimension, starting close to one edge and ranging outward almost cornerwise through the stick. Beginning close to the bottom of the silo, make these hoop holes the following distances apart: from 1st to 2nd, 2 feet; 2nd to 3rd, 2 feet; 3rd to 4th and 4th to 5th, each 3 feet; and the next five each 4 feet apart. The 2 by 4 do not need planing, but care must be taken to get straight pieces and clear. Southern pine is excellent for this work.

To Set Up.—First set up the 4 posts, brace well, plumb, and toenail to the sill. Make sure each is equidistant from the center of the silo to be, or in other words, in a circle. Put in the lower hoops and start the nuts, then stand a 2 by 4 inside these hoops, spike it soundly to the post, using a six-inch spike and driving straight through the 2 by 4 edgewise, set up another and do the same by that to the first stave. Keep this up around the silo, make sure to alternate the 12-foot and the 16-foot stave, so as to break joints above. Figure 13 shows a silo in course of construction. When all staves are in place screw up the

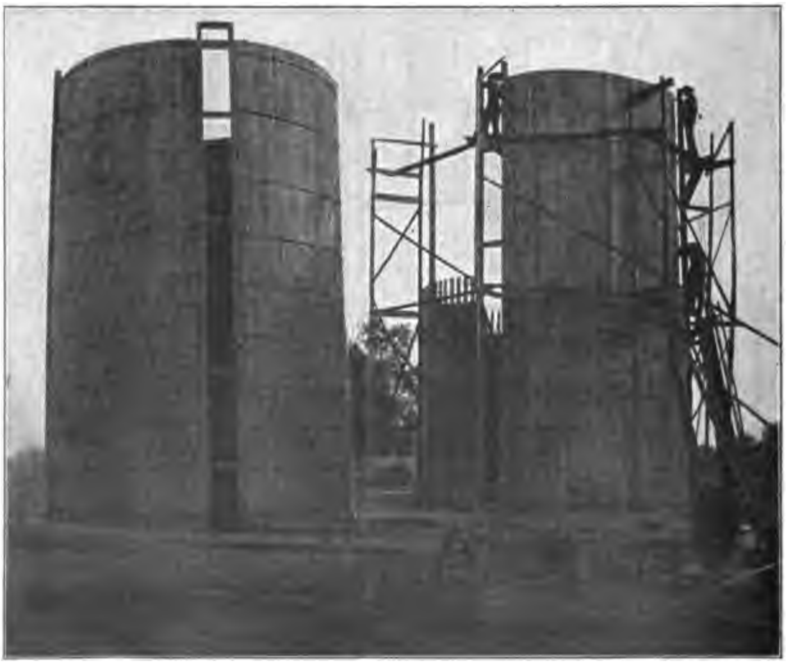


Figure 13. Two "Buff Jersey" silos in process of building. Note the way the 2x4's are made to break joints.

(Cut loaned by "Buff Jersey," Monmouth, Ill.)

nuts snug against the posts. This makes a very durable silo, and one that will not shell to pieces when empty and dry.

All this work is, of course, far easier said than done, but can be done by any handy farmer who wills to do it.

Doors.—On the side most convenient for feeding nail two strips across five of the staves and saw out these five some 30 inches long, saw on the bevel, as shown in figure 14, making the door longest on the inside. It would be well to have marked out these places when first putting staves up, so avoid sawing into any spikes. Jambs can then be finally nailed on outside of silo and the surface of contact made tight with felt strips. The doors (four would be sufficient) should be numbered, and each carefully kept for its own opening. Two other 4x6 pieces, one placed on either side of the doorway to strengthen that part of the silo, would be of value. Bore holes straight through these to allow for the passage of the hoops.

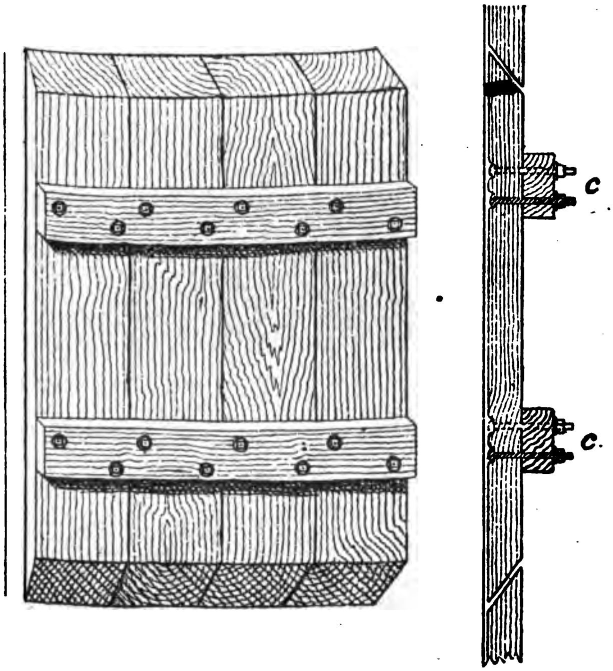


Figure 14. Cut showing way to saw four or five of the 2x4's from a home-made stave silo to make doors. Note the bevel in the sawing, the door "C C" is the largest on the inside.

Mr. McNish of Brookfield, Mo., has two of this kind, of which he says: "One is 16 by 24 and cost me $80, and the other is 12 by 26 and cost me $60."

Mr. Wm. Plummer, Hale, Mo., has two of these "Buff Jersey" silos and is well pleased with them. One is 16 by 34 and the other is 20 by 34. See figure 20.

Mr. John Miles, Grays Summit, Mo., has one 20 by 30, and is pleased with it. See figure 15.

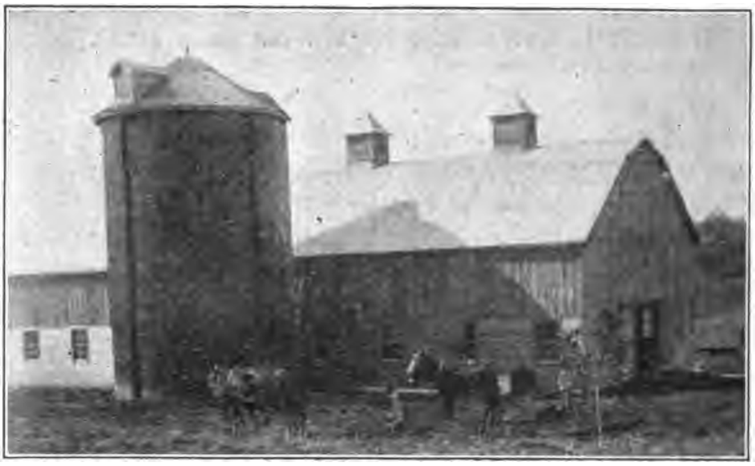


Figure 15. Silo and barn on the farm of J. A. Miles, Gray's Summit, Mo. (Courtesy Rural World.)

WHAT TO GROW FOR THE SILO.

Corn.—For a silage crop corn comes first. It is by all means the most important. It yields heavily and is relished by all farm animals. Some experienced men prefer to plant thickly and not count on getting ears, but the majority of the best men seem to prefer to plant the silo corn the same as the field corn that is intended to mature grain. Plant as large a variety as will mature before frost in your locality, then let it get almost ripe. It should be cut when the grain is in the dry dough stage, or just beginning to glaze or dent. Corn silage properly made is fully as digestible as the dry fodder, and far more palatable. About the only objection that could be raised to corn is the fact that this plant is fattening in its tendencies and not a muscle and milk producing food, or in other words, its nutritive ratio is wide, it being 1 to 14.4, *i. e.* 1 part of protein to 14.4 parts of carbohydrates and fat. To correct this tendency, cow peas, soy beans and velvet beans are coming into favor.

Cow peas are grown and put into the silo along with the corn. Cow peas green have a nutritive value of 1 to 4.7, hence, by putting these into the silo with corn the ratio may be brought down to 1 to 8 or 9, which is about right for feeding steers and nearly low enough for dairy cows.

To test this point, Prof. C. G. Williams of Ohio divided his herd into two groups, feeding to one group silage composed of corn, cow peas and soy beans, mixed hay and four pounds of grain, and to the other group corn stover, mixed hay and 13.5 pounds of grain per day. The actual amount of digestible food was as nearly the same in each as could be wished. The two sections were fed this for an entire winter. Each cow was charged with what she consumed and credited with what she gave. At the end of the four months the following results were found: "The cows fed on the silage ration produced 96.7 pounds of milk and 5.08 pounds of butter fat per 100 pounds of dry matter. The cows fed the grain ration produced 81.3 pounds of milk and 3.9 pounds of butter fat per 100 pounds of dry matter. The cost of feed per 100 pounds of milk was $0.687 with the silage ration, and $1.055 with the grain ration. The cost of feed per pound of butter fat was 13.1 cents with the silage ration and 22.1 cents with the grain ration. The average net profit per

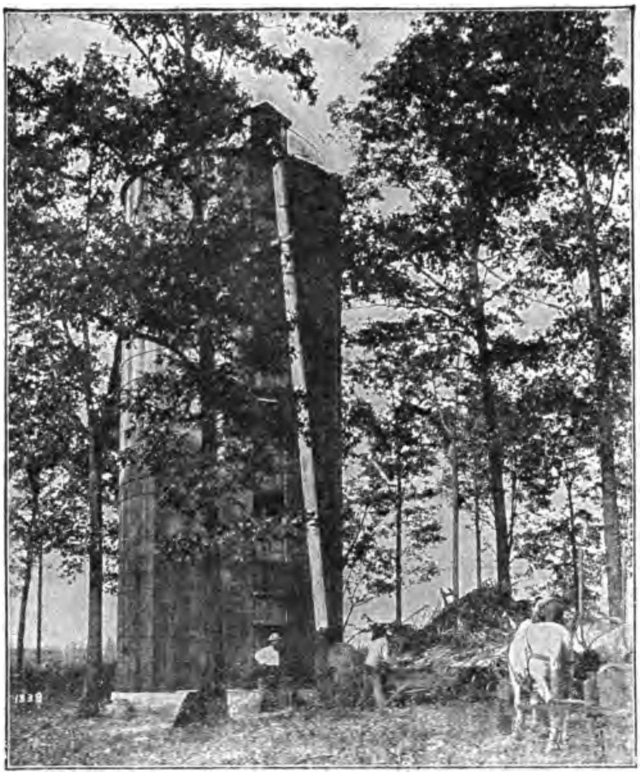


Figure 16. Filling 260-ton stave silo at World's Fair, St. Louis, Mo. This silo is 40 feet high and was filled with blower elevator. Mr. C. T. Graves, Maitland, Mo., Superintendent Jersey Cattle, stands near the silo.

(Courtesy Silver Mfg. Co.)

cow per month (over cost of feed) was $5.864 with the silage ration and $2.465 with the grain ration."

The above record is not quite complete for the farmer, however, until the effect of these several crops on the soil is considered. Corn, like other grains, is depleting to the soil, while cow peas and soy beans add about $10 worth of plant food to each acre each season. They can be sown in drills or broadcasted after the wheat is off in June, and be removed in September in time to allow another crop of wheat on the same land if desired. For the good of the soil and for the good of the cows, these two crops, corn and cow peas, should go hand in hand whenever possible.

Soy beans occupy practically the same place as cow peas as food for stock.

Clover has been made into silage with good results, but it is not yet a common crop for the silo. Where it can be cured it serves a better purpose as hay.

Alfalfa is also ensiled with good effect in some places. In California some advise putting alfalfa into the silo if it is mixed with foxtail. This seems to disarm the foxtail, but alfalfa, like clover, is more useful as hay.

Sorghum is often made into silage, and is highly recommended, especially for beef stock and sheep. It is good for the dairy cow, but being so rich in sugar, it would call for a greater expenditure for concentrated protein foods than would corn. Sorghum silage is very fattening and at the same time keeps the system of the animal in excellent condition.

Sunflower silage has been recommended, and doubtless would be fine if the stock would eat it more readily. Some cows refuse it altogether.

Grasses have been preserved in the silo, but there is little reason for this practice, because most grasses cure so readily as hay.

Beet tops and pulp in regions of the sugar beet industry are becoming popular as silage. This is especially the case in Europe.

Hash. The silo is sometime used as "catch-all" for left-overs. In the eastern states, where feed is high in price and strict economy essential, any Canada field peas and oats left over from the early feeding, later, crimson clover, rye, cow peas and corn, find their way into this preserver. All manner of odds and ends may be made into good food. Alvord once said that "a mixture of equal parts of ragweed, swamp grass or swale hay, old corn stalks or straw and second crop green clover, nearly three-fourths of which would otherwise be almost useless, will make a superior silage, surprising to those who have never tried it." The same author gives the following as the contents of one New York silo: 1st, 18 inches deep of green oats; 2nd, 6 inches of red clover; 3rd, 6 inches of Canada field peas; 4th, 3 inches of brewers' grains; 5th, 2 feet of whole corn plants sowed broadcast, and more ragweed than corn; 6th, 5 inches of second crop grass; 7th, 5 inches of sorghum; 8th, a lot of immature corn cut in short lengths. The silage came out pretty acid, but good forage, all eaten up clean."

The writer has put small quantities of common straw and salt hay (coarse hay from the tide meadows along the sea coast) into the silo along with the corn, and seen the cows in winter eat it all as though it were green grass.

FILLING THE SILO.

When to Cut the Corn.—When the corn has reached the three-fourths ripe stage, the stalks still green and the bottom leaves are drying, it should be cut and put directly into the silo. If the corn is not at all mature and is very watery the silage will most likely be very acid, while if the corn goes in dry it will mould, or "fire-fang," so that it will be greatly or wholly damaged.

Adding Water to Dry Corn.—If the corn, for any reason, has become dry while standing or in the shock, it may still be made into good silage by wetting it thoroughly when it is put into the silo. A half barrel of water to the load of corn will not be too much if the corn is quite dry.

Last fall, at the Missouri Experiment Station, two silos were filled with corn from the same field and in same condition. Each silo was air tight and the silage was equally well tramped in each. The only difference between them was that one, a new one, had no roof. Just after the two were filled it began to rain. The sickness of the professor in charge, the resignation of the farm foreman and a general piling up of work caused the silo to remain open to the rain from September 10, when it was filled to November 15, when cover was provided. The silo is 20 feet in diameter and water tight on sides and bottom. During this period of time 16.68 inches of rain fell. This silage was then forced to absorb 436.68 cubic feet, or 103.7 barrels of water. The silage was only 25 feet deep in the silo. There were then 7,854 cubic feet of silage to absorb 3,266.5 gallons of water, or one and two-third quarts of water per cubic foot of silage.

This water fell soon after the silage was put in, scarcely any falling in November. This silage came out better by considerable than that from the silo which had a roof. Some farmers make a practice of letting the corn dry in the field 3 or 4 days before hauling in to make lighter work, and then wet the silage well while it is being put into the silo.

Mr. Jones of Roanoke, Mo., has no roof on his silo, which was filled in September and caught the rain all winter. His silage is very good. He says the only use there is for a roof is to keep the snow out while it is being fed from; rain cannot harm it.

Mr. H. B. Gurler of DeKalb, Ill., has one silo in the pasture which he has used for eight years without any roof. It is 37 feet in diameter.

The average rainfall in this part of Illinois is 36 inches, yet the silage from this silo is as good as that from his other five silos that have roofs. The water benefits by forcing the air out and packing the contents, and thus preventing decay of the silage.

For best results, cut the corn when it is pretty well matured, even to the point of beginning to dry, then add a lot of water while filling. When in doubt whether to use water, use it; there seems to be no danger of getting too much water.

Tramping the Silage.—Even much tramping by heavy men will not do any particular good except around close to the wall, where it should be walked on well. The surface of the silage while being filled should be concave, low in the center and high about the sides. This done, the silage will not settle away from the walls. It is just the reverse process to stacking hay. Keep the corn chunks well mixed with the lighter stuff, so that at feeding time the animals fed will receive a uniform ration.

Necessary Machinery.—The silage cutter with carrier or blower to elevate the cut corn to the silo and an engine to run it are needed. It does not pay to "fiddle" around with a small cutter. Get one with knives 14 to 18 inches long, then provide power to make it go. Those who have used both carrier and blower to elevate the cut corn prefer the blower, it generally saves stopping to fix the carrier. The blower will not clog if the cutter is placed close to the silo, so that the wind is almost directly under the stuff carried. The following approximate figures may be of value:

No. of knives.	Length of knives, inches.	Cost.	Weight, lbs.	Capacity per hour, tons.	Horsepower needed.
2	11	$40	440	3-4	2-3
4	13	65	560	4-6	3-4
4	16	90	620	5-10	4-6
4	18	120	700	9-12	6-8
WITH SELF-FEEDER ATTACHMENT.					
4	13	95	775	8-12	5-6
4	16	120	835	12-15	7-8
4	18	155	875	14-20	7-10
4	19	200	1100	20-25	10-12
4	20	250	1600	20-27	10-12
4	24	300	1700	25-30	12-15

The catalog prices named above do not include the carrier or blower, which come extra at about $2 per foot for carrier and $1 per foot for blower. The cutter for blower will cost a little more than for carrier. The price will also vary with the make of machine. The prices are also reduced by a per cent discount, which varies somewhat with the different firms. When you decide to buy select the size that will best suit your needs and correspond with a few reliable dealers. The discount is often surprising. Occasionally one outfit is purchased by a neighborhood and used for filling a dozen or more silos, and occasionally a rig is owned and worked from place to place, the same as a threshing machine, charging so much per ton or per day, but when the silo is to be filled largely by help on the place, or is to be filled at different times as a catch-all, it is far more satisfactory to establish the cutter, house it in, and keep it always ready for use. The horse-power named was steam power; if a gasoline engine is used, increase the rated power about one-third.

Necessary Help.—When the cutter is running it is poor economy to allow it to run empty a part of the time. Better hire more help and keep the thing doing business all the time it is on expense. To keep it running 8 or 10 men will be needed, placed as follows: one engineer, one feeder, one in silo, one in field with team cutting corn, and four to six men, each with a team, to draw corn to the machine. To save useless labor the wagons should be low, a low truck with platform, or better, a suspended flat bed between the fore and rear wheels. This saves a large amount of useless lifting of heavy corn. See figure 17.

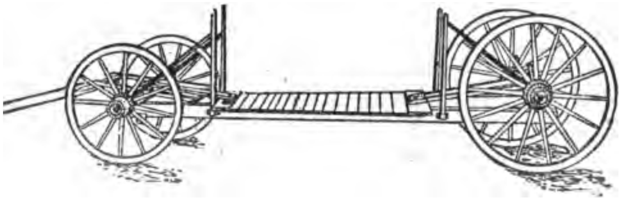


Figure 17. Low down wagon for hauling green corn.

Cost of Filling.—King, of the Wisconsin Experiment Station, studied this problem on a number of farms in Wisconsin and found that on an average it cost 58.6 cents to put one ton of green corn into the silo. Glover of Illinois studied the question in Illinois at a later date, when more improved machinery was being used, and found that the modern machinery enables a man now to do much more than he could 10 or 15 years ago. According to his figures, it would cost 40 cents a ton. It is usually considered that 50 cents a ton will cover the cost of filling. Many men, who have had experience in both methods, claim that it is just as cheap, and more satisfactory to make silage, as it is to cut, shock, husk and grind the corn for the cows.

A SETTLED THING.

Agricultural College, N. D., Oct. 6, 1903.

Gentlemen—I have used one of your * * * ensilage cutters for several seasons and am well pleased with the grade of work it does. The No. 19 * * * self-feed ensilage cutters with blower elevator purchased this season for use at the Agricultural College, has done its work satisfactorily.

I was doubtful at first about the blower attachment elevating the green fodder 30 feet high into the silo. I find, however, that the only trouble was to stop the ensilage when it reached the top, for when we first started, it shot across and broke the dormer window on the opposite side, 24 feet away.

The ensilage cutter we used here before had an ordinary chain elevator. Our silo at that time was only 20 feet high, but we had a great deal of trouble with the elevator. We were constantly having to stop to repair or adjust it, but with your machine the only trouble is to get the green corn to it fast enough. * * *

Yours respectfully,

J. H. Shepperd,
Dean and Vice Director.

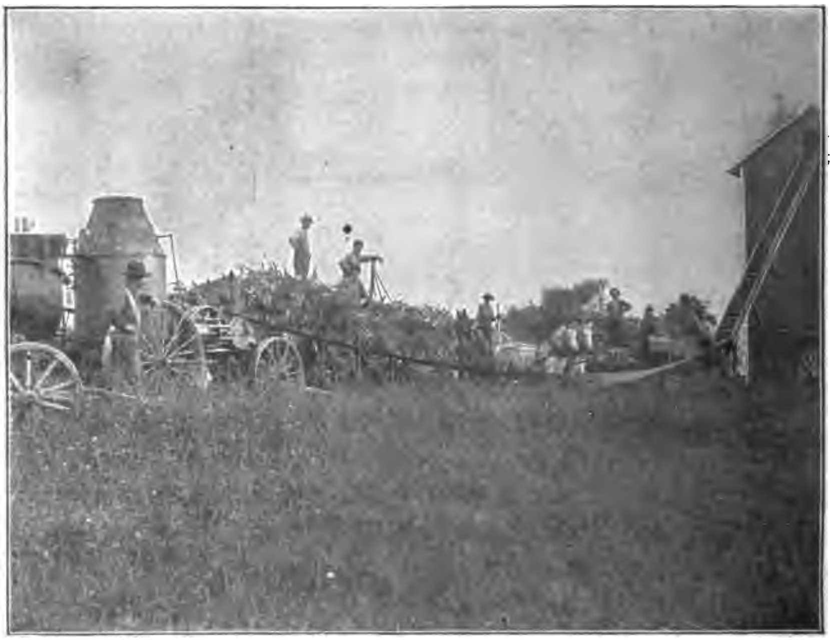


Figure 18. This is the rig that filled 20 silos in one season.

RATE OF WORK.

* * * Edinboro, Erie Co., Pa., Mar. 8, 1904.

Dear Sirs—I send you a photograph of my No. 20, special self-feed ensilage cutter, with 45-foot swivel carrier, which has given me and my customers the best of satisfaction. This machine was driven with a 12-horse-power Westinghouse engine, which furnished plenty of power, and at time picture was taken we were cutting 20 tons an hour, or as fast as corn could be got to the machine. There were five teams hauling and 14 men working besides our crew of men and the corn was close by. * * * * We filled 20 silos this season and were always ready for business. * * * *

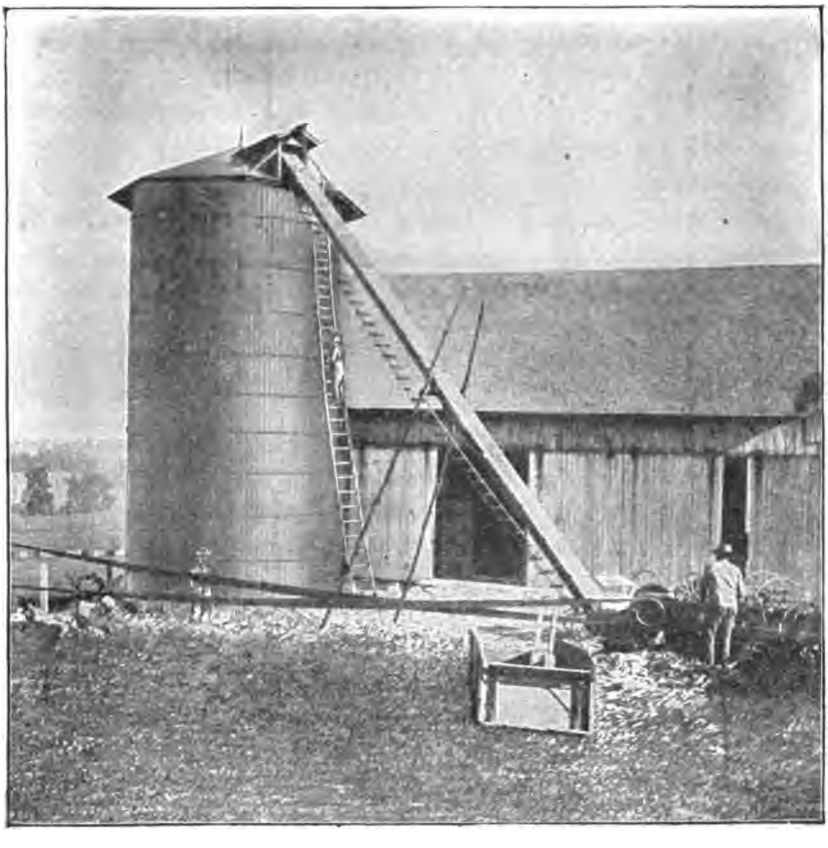


Figure 19. Filling silo with swivel carrier cutter.

Yours very truly,

A. B. Austin.

SELF-FEEDER.

* * * * Salem, Ohio, June 10, 1903.

Gentlemen—The No. 16 * * * self-feed ensilage cutter and swivel carrier we have been using the past three seasons, with which to fill seven large silos, has proven entirely satisfactory and fulfills the guarantee. We usually have four teams to haul the corn in from the field, and have never yet been able to keep the machine continuously supplied. The self-feed saves two men at the cutter and adds materially to its capacity.

Very respectfully,

O. E. WHINNERY, Dairyman.

SOMETHING DOING.

Three 550-ton silos and one 1,500-ton silo readily filled with two No. 19 * * * * cutters and blowers.

Washington Courthouse, Ohio, Feb. 2, 1903.

* * * Mfg. Co. * * *

Dear Sirs—During the year 1901 we used one of your No. 19 ensilage cutters, with blower attachment, and found the same to be eminently satisfactory. The machine is capable of doing all that you claim for it, and upon actual tests we were able, at times, to put into a silo, 42 feet high, corn ensilage at the rate of 30 tons per hour, using a 16-horse-power engine.

It was entirely practical to cut at the rate of 12 to 20 tons per hour during the whole day's time. During the year we had three 550-ton silos to fill and were under the necessity of getting a cutter which would do the work rapidly in order to get them filled in time. During the past year we filled, in addition to the silos mentioned, a large silo of 1,500 tons capacity, which is 52 feet in height. We filled all of these silos with two of your No. 19 cutters.

Yours truly,

HUMPHREY JONES.

A CAUTION.

It would not be right to close this subject without mentioning one feature which is often neglected in a discussion of the merits of the silo. When green feeds are piled up they always begin to heat. This rotting process, which causes the heat, at the same time causes large quantities of carbonic acid gas to be given off. If the silo has been filled quickly it will settle several feet and while doing so generates this gas. If all doors inside of silos were closed when it was first filled and the silage settled down to, say 8 or 10 feet below any opening, this apparently empty bin will be filled with gas. It is heavier than air and will flow out if it has a chance; give it the chance before sending any one in there to work. Running in fresh material will soon stir this gas up with the air and make it safe.

There is just enough danger here to make it wise to notice the conditions in the morning when starting up.

THE FEEDING OF SILAGE.

To Dairy Cows.—Cows unaccustomed to silage will become very fond of it in two or three days. They then eat of it as greedily as of green fodder. They eat more of it than they would of dry feed, and, therefore, have more food in their systems with which to make milk after they have subtracted their regular allowance for support. Then, too, food that is relished will be more thoroughly digested than that eaten with repugnance. The bowels of the silage-fed cow are as loose as though on blue grass pasture. This insures health and easy delivery of calves, and lastly, they will, according to Professor Williams' test, give more milk and butter fat per unit of food eaten than those that get only dry food.

The quality of the milk will not be injured in the least, even when the cows are fed heavily, 35 to 40 pounds per day, if the silage be fed after milking instead of just before, and if no silage is allowed to remain in the manger, under the cow, or in a heap in the passages to ferment. Feed only as much as the cow will eat up clean, 30 to 40 pounds per day, and keep the alleys clean. It is the abuse of silage, not its use, that has brought it into disfavor in some quarters. Mr. H. B. Gurler, who produces exceptionally fine milk for infant feeding in Chicago, uses silage freely, but not carelessly. The writer has had 8 years' experience with silage-fed cows and their milk and has not had any trouble with bad odor or acid in the milk or butter from it.

To Bulls.—By some it is still considered doubtful whether a full feed of silage is good for breeding bulls, claiming that it has a tendency to make them heavy, slow and uncertain. The writer once fed a mature Holstein bull a ration of 40 to 50 pounds of corn silage a day for a period of six months with excellent results. He got over a hundred robust calves that year, and was exceedingly active and sure. He received a little grain, but only 2 to 3 pounds of hay a day.

Mr. William Plummer, Hale, Carroll county, Mo., feeds silage to dairy cows and calves and says: "Our cows milk fine all winter and come out in good order in the spring. I couldn't get along without my silo now."

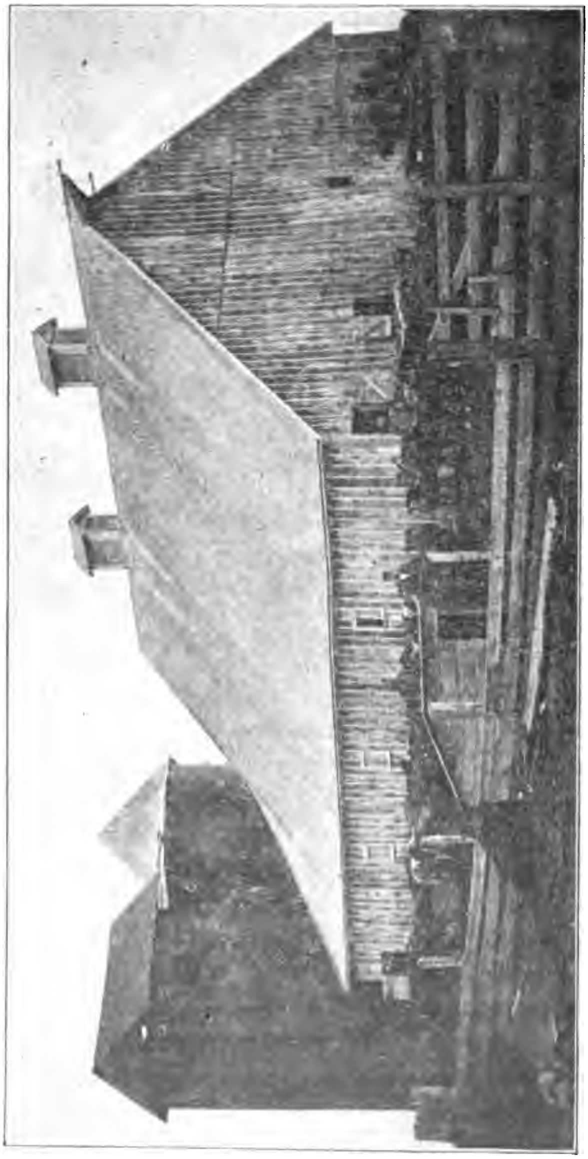


Figure 20. This cut shows the barn and silos of Mr. Wm. Plummer, Hale, Mo.

Mr. H. C. Goodrich, Calhoun, Henry county, Mo., says: "No dairyman can afford to be without a silo. I consider it the best and cheapest way to save the whole corn crop. I have fed ensilage to dairy cows for 12 or 13 years."

Mr. Jas. Elliot, Windsor, Henry county, Mo., feeds silage to cows and young stock and says: "I like ensilage for feeding very well. Would not like to be without one. It is not only good feed for cows but all kinds of cattle, and when it is put up in the fall it is so much easier to get at than to have to go to the fields for corn fodder; with ensilage we get the whole corn plant for food."

Mr. Fred Parcher, Maryville, Nodaway county, Mo., feeds silage to cows and young cattle and says: "Results in a saving of one-half in feed store bills and over one-half in amount of hay eaten."

Mr. H. S. Hand, Appleton City, St. Clair county, Mo., says: "I find it (silage) excellent for dairy cows. Our cows milk as well in winter as they do in summer; in fact, they usually gain when we commence to feed."

Mr. John Miles, Gray's Summit, Franklin county, Mo., feeds silage to dairy cows and horses and says: "Results are good. I like it well and think it an ideal method of securing succulent food."

Mr. Fritz Sensor, Corder, Lafayette county, Mo., says: "I have been feeding it to all of my cattle. It is of most value for milk cows."

Mr. John Patterson, Kirksville, Adair county, Mo., has fed silage for many years and says of it: "When I speak of the economy of putting corn into silos to feed cows I don't mean that it is good for cows only—it is good for all kinds of stock. All seem to like it and thrive on it, and when you get buildings and machinery for it, it does not cost any more to put it in silos than to cut and shock, etc., and it is much more convenient to feed in barns or sheds where stock can be comfortable and all the manure can be saved."

Mr. N. H. Gentry, Sedalia, Mo., says: "I put up a silo in the past summer 30 feet high by 20 in diameter. We filled it with cut corn and it is proving a very cheap, economical feed. We are feeding it to all our cattle, and our work horses have had no other grain all winter, keeping in good condition. In thus consuming the whole corn plant it proves a very cheap feed. We mix a little other grain with it in feeding milk cows and young cattle we wish to push along, but the dry cows get nothing but it, and they eat very little hay. I think I will put up a smaller silo for summer feeding in case of severe drouth, and after carrying it through the summer and it is not needed, we can feed it out during the winter or fall."

Mr. H. B. Gurler, who produces certified milk from 150 cows, some of which milk was sent to Paris, France, and was still sweet at the end of 21 days, though no preservative but cleanliness and cold were used, says of the silage: "I have been using silage for 25 years. I was enthusiastic from the first. I never went crazy over it, but my confidence has been increasing from year to year, and I never was so firmly fixed in the opinion that it is a necessity on the farm as I am now. There is no better feed for producing perfectly sweet milk than silage fed properly."

Mr. C. T. Graves, Maitland, Mo., had charge of the Jerseys at the World's Fair in 1904, and the excellent showing made there was partly due to the superior corn silage that was fed.

Redmond & Hurst, Tipton, Moniteau county, Mo., uses two "bin" silos and says: "We are milking 50 cows in all stages of lactation, 10 of which are heifers with first calf, and our check for January cream was $265.00; not so bad for winter.

Cows giving milk should be fed from 30 to 40 pounds of silage a day, half in the morning and half at night, or as much as they will eat up *clean* every time. If a little is left in the manger take it out before it spoils—and next time feed a little less. After the silage is cleaned up give as much alfalfa, clover or cow pea hay as the animal will clean up readily. Mix the grain 1 part cottonseed meal to 6 parts corn and cob meal; or 1 part oil meal to 5 parts corn and cob meal; or 1 part bran to 3 parts corn and cob meal. Then give of this mixture one pound for every three pounds of milk the cow is giving per day. If the cow gives 6 pounds (3 quarts) of milk a day, feed 2 pounds of grain; if 30 pounds (15 quarts), give 10 pounds grain, etc. Oats may be substituted for the bran, or gluten meal for the oil meal. This will give as nearly a balanced ration as need be attempted.

To Beef Stock.—Corn or sorghum silage fed to beef cattle keeps them in tone and enables them to make better use of other food consumed. From 30 to 40 pounds per day will not be too much when once they are gotten onto full feed. Several of our experiment stations, after careful trials, recommend it highly.

In the summary of Bulletin 73, Illinois Experiment Station, is found: "It requires a third longer to feed an acre of corn silage than an acre of shock corn. * * * The silage-fed steers were in much better thrift and flesh at the end of the experiment (88 days) than were the shock-fed steers. * * * It should be noted that the silage-fed lot consumed less feed than the shock-corn lot and less feed per pound of gain. The amount of dry matter required to produce a pound of gain of meat, when the corn was fed in the form of silage, was 6.52 pounds; where fed in the form of shock corn it was 8.57 pounds."

Mr. J. M. Doughty, herdsman, Missouri Experiment Station, says: "The Experiment Station beef-breeding herd is being kept through the winter on silage and alfalfa without grain. Mature cows receive 25 to

30 pounds of silage at night and a feed of hay in the morning. A few of the cows did not take to the silage at first, but they all learned to relish it and they never leave any silage, although a little hay is left occasionally. I believe that if farmers only knew the value of silage for feeding cows and maintaining steers silos would soon become numerous."

Mr. McNish of Brookfield, Mo., has two silos. He says: "I feed all classes of cattle with good results, especially for growing stock. I fed a car load of steers silage and ear corn and topped the market. The only difficulty in feeding the silage with ear corn is that the cattle which are to be fattened will quit eating the ear corn and eat the silage alone. Corn, I believe, should be ground when feeding with silage for fattening steers."

Mr. H. S. Hand, Appleton City, Mo., says: "I feed all kinds of stock on silage with good results. I have used it for stall feeding with ground corn, cob and all. Would not think of wintering stock without silage. We are feeding 300 head of cattle and find the silo a great saver of feed."

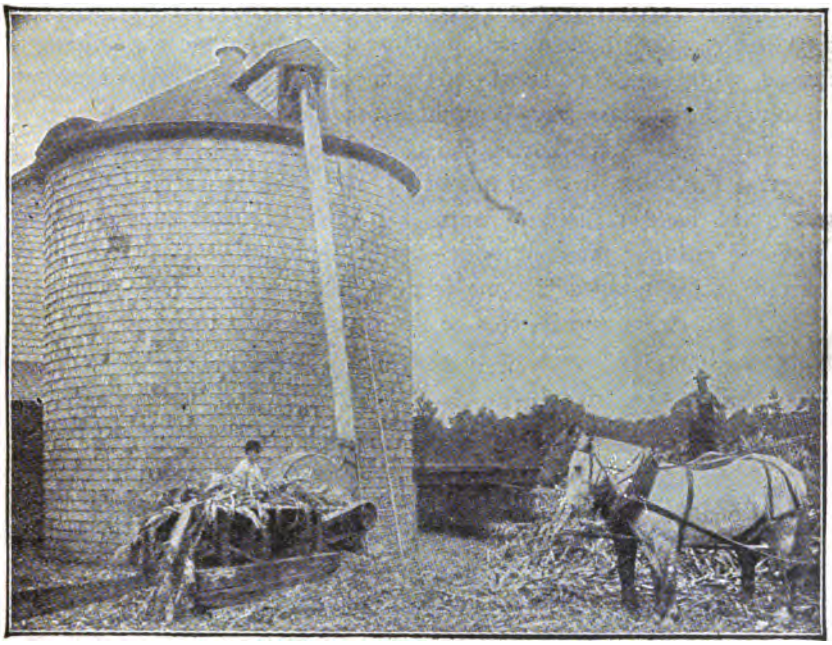


Figure 22. A round-shingled silo being filled with a blower cutter. (Courtesy Silver Mfg. Co., Salem, Ohio.)

"Humphrey Jones of Washington Court House, Ohio, constructed three silos in 1901, which he made 26 feet in diameter and 36 feet high, holding each from 500 to 600 tons. In 1902 he built another, 39 feet wide and 52 feet high, of cement. Mr. Jones has found great advantage in feeding silage to cattle. His silage consists of three-quarters corn and one-quarter soy beans, cut in the fullest maturity. Some of the advantages, as outlined by him, are a greater feeding value of corn than when fed dry, making gains cheaper; getting cattle to feed better; finishing up cattle better and more evenly on market, and its adaptability to stock cattle. Corn that will make 50 bushels per acre will yield 8 tons of silage, which he values at $2.50 a ton. He regards a feed of about 5 pounds of silage and one-third of a pound of hay for each hundred pounds live weight a satisfactory feed. A steer will hardly consume over 50 pounds of silage a day, if either 1,000 or 1,300 pounds weight. Mr. Jones feeds, he assumes, about 1 pound of grain in his silage to a hundred pounds of live weight, and he also gives about one-half pound of cottonseed meal with the silage per hundred pounds of live weight. Cattle rarely eat over 4 pounds of hay per day when fed silage freely. The daily cost of feed for a silage-fed steer was given at 11 cents, while one corn-shock-fed will cost 20 cents. No discrimination occurred against silage-fed animals on the market."

To Horses.—If the horses can be taught to relish silage, it will be very good for them in small quantities, say from 10 to 20 pounds per day. Some have refused to learn, but most of them will soon learn to like the peculiar pungent odor, especially if aided at first by some of nature's "plain sauce." Some feeders mix one part corn silage and two parts cut straw and let this be the regular diet. A horse fed moderately of silage will have a more glossy coat, looser skin, and in general, greater evidence of thrift than one fed wholly on dry food. Idle horses may receive more than those at work, and heavy horses more than drivers.

To Sheep.—To be wintered through in best form, sheep must have some succulent food, and for this purpose a great many mangels, rutabagas, turnips, etc., were formerly raised, but at present corn or sorghum silage is getting to be looked upon with great favor. Fattening stock respond well to the sugar in sorghum and corn silage, especially when there are nubbins of corn throughout the chopped corn stalks. For ewes in lamb, silage is most excellent. It allows them to drop their lambs in January or February without trouble and increases the milk flow very materially. The lambs are strong and healthy and ready to respond to feed and come onto the early market with profit. From 3 to 4 pounds a day per head is sufficient. Like other farm animals, they require some dry hay every day. This hay would best be alfalfa, clover or cow pea, as these feeds contain the protein so essential to economical feeding. Mr. J. M. Turner of Michigan says, "Of late years we have annually put up 3,200 tons of corn ensilage, and this has been the principal ration of all the live stock at Springdale farm, our Shropshire sheep having been maintained on a ration of ensilage night and morning, coupled with a small ration of clover hay in the middle of the day."

To Swine.—As a food for swine there is some conflict of opinion. Some feeders, including the writer, have fed it with very indifferent success, while others make a practice of feeding it and claim that in small quantities it substitutes pasture and keeps the swine in better thrift than when fed slop and grains without the succulent adjunct. Mr. J. W. Pierce of Indiana writes on this subject: "We have fed our sows, about 25 in number, for four winters, equal parts of ensilage and corn meal put into a cooker and brought up to the steaming state. It has proved very beneficial to them. It keeps up the flow of milk of the sows that are nursing the young, equal to when they are running on clover. We find, too, that when the pigs are farrowed they become more robust, and take to nursing much sooner and better than they did in winters when fed on an exclusively dry diet. We also fed it to our sheep. To sixty head we put out about six bushels of ensilage." That a pig should eat silage is no more than we should expect from an animal that feeds on pasture grass as well as hogs do.

To Poultry.—Poultry in winter crave green food. Some poultry farmers provide cabbages, others crushed roots, but there is a strong tendency now to provide a silage made of tender clover and green sweet corn. A poultry man writes as follows in "Orange Judd Farmer:" "Clover and corn ensilage is one of the best winter foods for poultry raisers. Let me tell you how to build four silos for $1. Buy four coal oil barrels at the drug store, burn them out on the inside, and take the heads out. Go to the clover field when the second crop of the small June clover is in bloom, and cut one-half ton three-eighths of an inch in length, also one-half ton of sweet corn, and run this through the feed cutter. Put into the barrel a layer of clover, then a layer of corn. Having done this, take a common building jack-screw and press the silage down as firmly as possible. Then put on this a very light sprinkling of pulverized charcoal, and keep on putting in clover and corn until you get the barrel as full as will admit the cover being put back. After the four-barrel silos are filled, roll them out beside the barn and cover them with horse manure, allowing them to remain there thirty days. Then put them away, covering with cut straw or hay. When the cold, chilling winds of December come, open one of these 'poultrymen's silos,' take about twenty pounds for one hundred hens, add equal parts of potatoes, ground oats and winter rye, place same in a kettle and bring to a boiling state. Feed warm in the morning, and the result will be that you will be able to market seven or eight dozen eggs per day from one hundred hens throughout the winter, when eggs bring good returns." When silage cannot be got, the fine leaves that break off from alfalfa and clover in the handling, when wet with warm water, are a good substitute.

As a Summer Convenience.—The silo is not restricted to winter use only. Summer silage feeding is getting to take the place of the soiling system. When land is high in price, cows are often fed in the stable the year round, in summer the green food being brought to them fresh from the fields every day. A larger number of cows can be kept in this way than by pasturing, but with the summer silo a still larger number may be maintained, and that, too, without the annoyance of being compelled to run to the field every day, rain or shine to cut and draw in a jag of green feed.

THE SILO IN THE SOUTH.

To preserve food for winter feeding in the south is more difficult than in the north. In the north a shock or stack of corn fodder may get snowed under, but remains green and palatable, while in the south, where the winter wetness is in the form of rain, an exposed stack of corn fodder would soon bleach tasteless if not rot outright.

The silo should be pushed as the winter pasture for the south as well as for the north.

Professor A. M. Soule, formerly of Tennessee, now of Virginia, speaking of silage for the south, says: "It is, however, clearly recognized as one of the most economical and satisfactory food stuffs obtainable. At the Tennessee Experiment Station four beef cattle have been maintained for 150 days on silage produced on 0.91 acre of land. Every farmer who is interested in the feeding and maintenance of live stock should have a silo."

Mr. C. L. Willoughby, professor of animal husbandry at the Georgia Experiment Station, Experiment, Ga., in reply to a letter on the subject, says: "The silo has been successful in Georgia for twenty years. I imagine the men who entered the dairy business at all in Georgia have been just as modern in the use of such conveniences as any class of men in America. Those who have used a silo say they could not possibly do without them. They are used all over Georgia, and even in the northern part of Florida, just as readily as in Missouri. We have a wide range of climate in this State. The elevated region in northern

Georgia has a climate very little different from that of the Ozarks, while the climate of south Georgia is almost sub-tropical.

"The most common type now being built is the ordinary wood stave silo with round hoops. Many of the silos built fifteen or twenty years ago were made of thick cement walls, usually square in shape, and some of these are in use yet. Good pine lumber is reasonably cheap here yet, so that a hundred-ton silo seldom costs more than $75.00.

"The principal crop used in the silo is corn, with sorghum as a close second. The corn is often mixed half and half with sorghum, and many dairymen grow cow peas or velvet beans with the corn, permitting the vine to climb up the stalk, and then running the vine and stalk together through the cutter. The pea vines or velvet beans do not make good silage alone.

"In a general way, the dairymen of south Georgia are compelled to use up their silage a little faster than you would in Missouri, on account of the warm climate hastening the rotting of the material."

The silo for the south should be made a little narrower for its capacity than those in the north, in order that the silage may be fed down more rapidly. About 6 square feet of silage surface for each cow per day will be sufficient. For 10 cows and a few young stock a silo should be then 10 feet in diameter and deep enough to hold the necessary amount.

A silo 10 feet in diameter and 25 feet deep will hold, approximately, 40 tons of silage, which will grow on 3 to 4 acres of ground and furnish feed for 10 cows and 6 to 8 head of young stock for 120 days.

While remembering its many advantages, yet not forgetting its limitations, the silo should be pushed in all parts of the country.

ANALYSES OF FEEDING STUFFS.

Table showing average amounts of digestible nutrients in the more common American fodders, grains and by-products. Compiled by the editors of Hoard's Dairyman, Fort Atkinson, Wis.

Name of feed.	Dry matter in 100 lbs.	Digestible nutrients in 100 lbs.		
		Protein........	Carbohydrates.	Ether extract. (Crude fat.)..
Green fodders—	Lbs.	Lbs.	Lbs.	Lbs.
Pasture grasses, mixed	20.0	2.5	10.2	0.5
Fodder corn	20.7	1.0	11.6	0.4
Sorghum	20.6	0.6	12.2	0.4
Red clover	29.2	2.9	14.8	0.7
Alfalfa	28.2	3.9	12.7	0.5
Cow pea	16.4	1.8	8.7	0.2
Soja bean	24.9	3.2	11.0	0.5
Oat fodder	37.8	2.6	18.9	1.0
Rye fodder	23.4	2.1	14.1	0.4
Rape	14.0	1.5	8.1	0.2
Peas and oats	16.0	1.8	7.1	0.2
Beet pulp	10.2	0.6	7.3	....
Silage—				
Corn	20.9	0.9	11.3	0.7
Corn, Wisconsin analyses	26.4	1.3	14.0	0.7
Sorghum	23.9	0.6	14.9	0.2
Red clover	28.0	2.0	13.5	1.0
Alfalfa	27.5	3.0	8.5	1.9
Cow pea	20.7	1.5	8.6	0.9
Soja bean	25.8	2.7	8.7	1.3
Dry fodder and hay—				
Corn fodder	57.8	2.5	34.6	1.2
Corn fodder, Wisconsin analyses	71.0	3.7	40.4	1.2
Corn stover	59.5	1.7	32.4	0.7
Sorghum fodder	59.7	1.5	37.3	0.4
Red clover	84.7	6.8	35.8	1.7
Alfalfa	91.6	11.0	39.6	1.2
Barley	85.2	6.2	46.6	1.5
Blue grass	78.8	4.8	37.3	2.0
Cow pea	89.3	10.8	38.6	1.1
Crab grass	82.4	5.7	39.7	1.4
Johnson grass	87.7	2.4	47.8	0.7
Marsh grass	88.4	2.4	29.9	0.9
Millet	92.3	4.5	51.7	1.3
Oat hay	91.1	4.3	46.4	1.5
Oat and pea hay	85.4	9.2	36.8	1.2
Orchard grass	90.1	4.9	42.3	1.4
Prairie grass	87.5	3.5	41.8	1.4
Red top	91.1	4.8	46.9	1.0
Timothy	86.8	2.8	43.4	1.4
Timothy and clover	85.3	4.8	39.6	1.6
Vetch	88.7	12.9	47.5	1.4
White daisy	85.0	3.8	40.7	1.2
Straw—				
Barley	85.8	0.7	41.2	0.6
Oat	90.8	1.2	38.6	0.8
Rye	92.9	0.6	40.6	0.4
Wheat	90.4	0.4	36.3	0.4
Roots and tubers—				
Artichokes	20.0	2.0	16.8	0.2
Beets, common	13.0	1.2	8.8	0.1
Beets, sugar	13.5	1.1	10.2	0.1
Carrots	11.4	0.8	7.8	0.2
Mangels	9.1	1.1	5.4	0.1
Parsnips	11.7	1.6	11.2	0.2
Potatoes	21.1	0.9	16.3	0.1
Rutabagas	11.4	1.0	8.1	0.2
Turnips	9.5	1.0	7.2	0.2
Sweet potatoes	29.0	0.9	22.2	0.3

ANALYSES OF FEEDING STUFFS—Continued.

Name of feed.	Dry matter in 100 lbs.	Digestible nutrients in 100 lbs.		
		Protein	Carbohydrates.	Ether extract. (Crude fat.)
Grain and by-products—				
Barley	89.1	8.7	65.6	1.6
Brewers' grains, dry	91.8	15.7	36.3	5.1
Brewers' grains, wet	24.3	3.9	9.3	1.4
Malt sprouts	89.8	18.6	37.1	1.7
Buckwheat	87.4	7.7	49.2	1.8
Buckwheat bran	89.5	7.4	30.4	1.9
Buckwheat middlings	87.3	22.0	33.4	5.4
Corn	89.1	7.9	66.7	4.3
Corn and cob meal	89.0	6.4	63.0	3.5
Corn cob	89.3	0.4	52.5	0.3
Corn bran	90.9	7.4	59.8	4.6
Atlas gluten meal	92.0	24.6	38.8	11.5
Gluten meal	88.0	32.1	41.2	2.5
Germ oil meal	90.0	20.2	44.5	8.8
Gluten feed	90.0	23.3	50.7	2.7
Hominy chop	88.9	7.5	55.2	6.8
Starch feed, wet	34.6	5.5	21.7	2.3
Cotton seed	89.7	12.5	30.0	17.3
Cotton seed meal	91.8	37.2	16.9	8.4
Cotton seed hulls	88.9	0.3	33.1	1.7
Cocoanut meal	89.7	15.6	38.3	10.5
Cow peas	85.2	18.3	54.2	1.1
Flax seed	90.8	20.6	17.1	29.0
Oil meal, old process	90.8	29.3	32.7	7.0
Oil meal, new process	89.9	28.2	40.1	2.8
Cleveland oil meal	89.6	32.1	25.1	2.6
Kaffir corn	84.8	7.8	57.1	2.7
Millet	86.0	8.9	45.0	3.2
Oats	89.0	9.2	47.3	4.2
Oat feed or shorts	92.3	12.5	46.9	2.8
Oat dust	93.5	8.9	38.4	5.1
Peas	89.5	16.8	51.8	0.7
Quaker dairy feed	92.5	9.4	50.1	3.0
Rye	88.4	9.9	67.6	1.1
Rye bran	88.4	11.5	50.3	2.0
Wheat	89.5	10.2	69.2	1.7
Wheat bran	88.1	12.6	38.6	3.0
Wheat middlings	87.9	12.8	53.0	3.4
Wheat shorts	88.2	12.2	50.0	3.8

WEIGHT OF CONCENTRATED FEEDS.

Kind of feed.	One quart equals.	One pound equals.
	Pounds.	Quarts.
Cottonseed meal	1.4	0.71
Linseed meal, old process	1.1	0.90
Gluten meal	1.8	0.55
Gluten feed	1.3	0.71
Germ oil meal	1.4	0.71
Brewers' grains	0.6	1.70
Malt sprouts	0.6	1.70
Wheat bran	0.5	2.00
Wheat middlings, standard	0.8	1.25
Wheat middlings, flour	1.2	0.83
Corn kernels	1.7	0.60
Corn meal	1.5	0.70
Corn and cob meal	1.4	0.67
Corn bran	0.5	2.00
Oat kernels	1.1	0.90
Oats, ground	0.7	1.40
Wheat kernels	1.9	0.53
H-O dairy feed	0.7	1.43
Quaker dairy feed	1.0	1.00
Victor corn and oatfeed	0.7	1.43

PRINCIPAL FACTS CONCERNING THE LIFE OF COLONEL GEORGE W. WATERS, DECEASED.

No greater service can be given to the State than to labor for the elevation and advancement of the industrial classes. The man who amasses wealth and contributes of his means to the support of the government is a useful citizen, but the man who gives his life for the upbuilding of his fellowmen is a benefactor to his race, a philanthropist worthy of the admiration of all mankind. Such a man was the subject of this article, the late Colonel George W. Waters. It may be truly said of him, he was aggressively honest, sincere and unselfish in his work, active and progressive, devoted to the welfare of his family, the community, the church and the State; and no greater tribute than this can be paid to any man. It is no discredit to any other to say that no man in this State has labored so long, so unselfishly and so effectively for the advancement of the cause of agriculture, a cause held sacred by Colonel Waters. Colonel Waters never considered his own comfort when duty called him. The weather was never too cold, the distance too far, or obstacles too great for him to overcome. "Greater love than this hath no man, that he lay down his life for a friend." Such was the love of Colonel Waters for the betterment of the farmers of Missouri. He sacrificed his life for a cause held sacred by him.

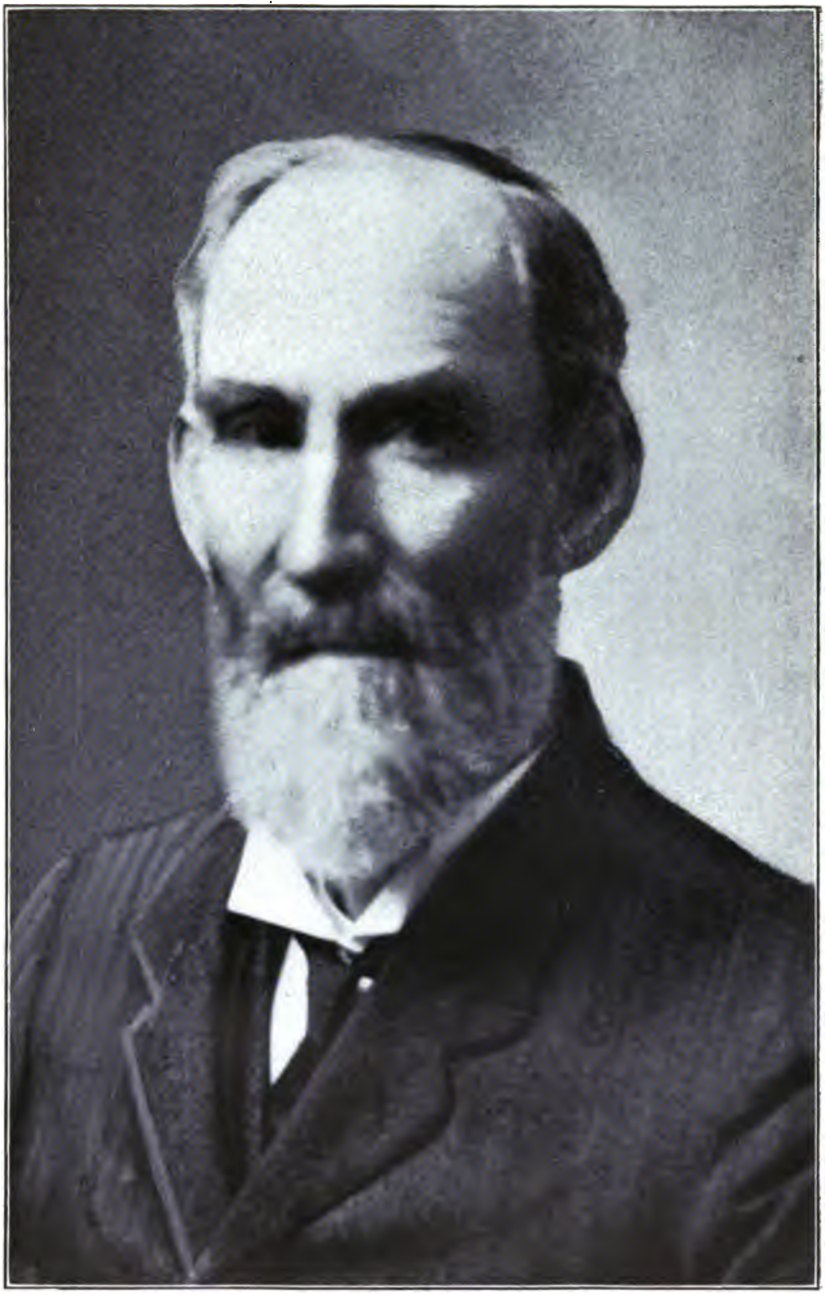
The following expressions, from those who were intimately acquainted with Colonel Waters, show in what high esteem he was held by the people of this State.

From "Colman's Rural World:"

George Washington Waters, born in Ralls county, Missouri, August 1, 1836, died in Hope, Arkansas, February 23, 1906, aged 70 years.

The elder George Waters, his father, moved from Wilson county, Tennessee, to Missouri in 1829, settling in Pike county at first, and later establishing a home on a farm in Ralls county, where the subject of this sketch was born.

George W. Waters' boyhood was probably that of the average country boy of the time in which he lived, and after having obtained such an education as was afforded by the public school system of that time, and such as his father, who, in addition to being a farmer, was a minister of the Gospel, could give him, he completed the work in the Fitting Academy at Louisiana, Missouri, and immediately entered the University of Arkansas, at Fayetteville, to prepare himself for a civil engineer. Just before graduating, in the spring of 1859, he retired from



COL. GEO. W. WATERS, DECEASED.

Born August, 1836. Died February 23, 1906.

The State has sustained an irreparable loss in the death of this great man.

the university on account of ill-health, and the war breaking out immediately thereafter, his university career was permanently ended.

He returned to his native State, married Lavinia, daughter of Alfred Smith, one of the early settlers of Ralls county, and lived for a short time on a farm in Pike county, Missouri, then returned to Ralls county and purchased a farm adjoining the one on which his father had settled. He remained on this farm until September, 1892, when he removed to Canton, Missouri, to have the advantages of the Christian University for his family, remaining there until December, 1905, when he moved to Hope, Arkansas, to establish a new home.

Among the chief characteristics of the man and of his career may be mentioned:

He was essentially a pioneer, a pathfinder, a leader. He was among the first men of his community to breed registered Shorthorn cattle and registered Cotswold sheep at first, and later Shropshires and Berkshire hogs. He was among the first of his community, and in the State, to adopt a systematic rotation of crops and a definite plan of building up of the fertility of his farm.

He was a student, a man to whom the intellectual side of farming appealed strongly, a man with a frail body, but a rugged, vigorous mind, a man who, at the age of fifty, becoming interested in the science of agriculture, was able to master the fundamentals, the underlying principles of the sciences in their relation to its practice, and to teach as sound agriculture as the man who had had the benefit of an agricultural college training.

In addition to this, his acquaintance with the practical part of this industry made his teaching of unusual value and importance.

He was a peacemaker, and throughout his whole life acted as a buffer between the contending elements of families, neighbors, political parties, etc., a friend to everybody at all times and under all circumstances.

He was a philanthropist, with no thought or care for personal advantage or gain, and willing to give his best thought and effort to the advancements of the interests of mankind.

Above all, he was a true, Christian gentleman, living the simple Christian life, ever ready to lend a helping hand to those in need. He was an elder in the church of his choice for nearly fifty years.

He is perhaps better known throughout the country as a farmers' institute lecturer and an agricultural writer than in any other way. He began his farmers' institute work in 1886, or seven years before any appropriation was made for this purpose by the State, and at a time when it was necessary for him to not only contribute his own time without compensation, but to bear his own expenses of travel, of advertising the meetings, etc., yet so earnest was the man in his desire to carry to the people the gospel of improved agriculture that he was willing, out of his very limited resources, to give all of this.

Later, when the farmers' institute service was organized under the auspices of the State Board of Agriculture, and the secretary was looking around for men who combined scientific knowledge with a familiarity of the practical phases of the subject, and with a disposition and temperament such as would arouse interest and attract favorable attention, he was selected among the first, and had continued actively in the work until a week before his death.

During the twenty years' service in this capacity he visited every county, and almost every community in Missouri. It is impossible to find any neighborhood that does not contain some man who knew him personally.

As an agricultural writer, he was best known through his contributions to the Rural World, extending over a period of more than thirty years. His articles were always strong, incisive, plain and practical.

As a promoter of the State's welfare, he was always active in connection with the expositions, having contributed practically all of the material that made up Missouri's agricultural exhibit at the Chicago Exposition, having been a commissioner for the Omaha Exposition, and having collected the bulk of material that was exhibited there, and having been assistant superintendent of the agricultural department for Missouri at the St. Louis Exposition. No man compared with him in his knowledge of the technique of growing and preparing material of this sort for exhibit, all of which he had mastered in the stern school of experience.

It may be truthfully said that he was the father of the good roads' movement in Missouri. He was the author of several road laws that were enacted by the Legislature, and first the promoter of the use of the drag for the improvement of dirt roads in the State.

It may likewise be said that he was at the beginning of the movement for the improvement of corn, and has contributed more to the success of this great undertaking than any other man in the State.

While he had lived his three score years and ten, he died at the high tide of his usefulness, in the harness, and still young at heart. It could never be said of Colonel Waters that he had grown old. He drew his inspiration from the future rather than from the past, and kept pace with modern progress.

His widow and seven children survive him, namely: Mrs. Lavinia J. Waters, his widow, at Hope, Arkansas; William S. Waters, merchant, Vandalia, Missouri; Henry J. Waters, Dean of the College of Agriculture, Columbia, Missouri; Mrs. John K. Briggs, Hope, Arkansas; Mrs. A. N. Lindsay, the wife of the Rev. A. N. Lindsay, New Franklin, Missouri; Rev. Baxter Waters, late pastor of the Central Christian church, St. Louis, at present pastor in Duluth, Minnesota; Miss Julia Waters, Hope, Arkansas, and Mrs. Carl G. Cummings, Canton, Missouri.

Hon. Alex. Maitland, Member State Board of Agriculture:

"Colonel Waters has been a valiant soldier for agriculture and an excellent man. It is true, he was like a shock of ripe grain, but no matter, the cause will miss him, as his kind never live so long, but we think it would be better for the world if they could stay longer."

Hon. C. O. Raine, Master State Grange:

"Colonel Waters was highly respected by all who knew him, and dearly loved by many for his honest, pure, Christian character."

Prof. W. R. Dodson, Director Louisiana Experiment Station:

"For many years I have known of the work Colonel Waters has been doing for progress in Agriculture. This good work sustains a great loss in him."

W. P. Harned, Vermont, Missouri:

"One who did the public great good without apparent care for self. He will stand as a benefactor to agriculture. While not a robust man, he lived a fair age, and it is a consolation to know that he finished his career in a useful life, loved and esteemed by his fellows."

F. P. Sever, Hurdland, Missouri:

"I never knew a man for whom I had a higher regard. His unassuming manner, his high sense of honor, his open, honest heart, generous and kindly disposition and other similar and worthy characteristics made him, in my estimation, a great and good man."

Hon. John W. Hill, Member of Board of Agriculture, Chillicothe:

"Colonel Waters has been a very useful man, and will be sincerely missed, not only by his family, but by the farmers of Missouri."

Hon. Thos. B. North, Member of Board of Agriculture:

"I believed Colonel Waters to be a good and useful citizen in any community, and I know that he has done a great deal of good for the agricultural and live stock interests in this State, and his death will be regretted by all who knew him."

Hon. E. E. Laughlin, President Missouri Corn Growers' Association:

"I feel I have lost a close friend. I held him in very high esteem."

Mr. C. D. Lyon, Georgetown, Ohio:

"Colonel Waters was a Missourian, the son of a minister, and was known in every county of the State as a famous institute speaker of rare ability. He was a practical farmer, fruit grower and stockman, and his counsel will be sadly missed. He did better work than any other man ever did among plain farmers."

SERVICES OF NORMAN J. COLMAN TO AMERICAN AGRICULTURE.

(Abstract of an address of Col. Chas. F. Mills of Springfield, Illinois, at the University of Illinois, on the occasion of conferring the degree of Doctor of Agriculture on Mr. Colman, October 18, 1905.)

Mr. President: The very pleasant duty has been assigned me of briefly referring on this very appropriate occasion and place to the services of Norman Jay Colman to American agriculture. The honor of my selection for this very agreeable duty is highly appreciated, and I enter upon its discharge with the conviction that the man and his eminent services to American agriculture are deserving of a far more gifted compiler.

To the student of our literature pertaining to the farm, Mr. Colman is well and widely known as second to none of the active and successful promoters of American agriculture. The very full reports of the highly creditable and far reaching work for good of Mr. Colman, in advancing the best conditions of our agriculture, are well known to this assembly. It is fortunate for the interested student that the results of his labors have been so fully and widely published in the official records of the National and State Departments of Agriculture, the farm press and in the books relating to advanced methods in rural husbandry.

My efforts will therefore be that of a compiler of the historical data necessary to complete the record for this occasion. All present, I believe will rejoice in this fitting opportunity to refer to the familiar and worthy achievements of a patriotic, painstaking man who has merited the distinguished honors so freely bestowed upon him by a conservative, discriminating and appreciative constituency.

Mr. Colman was born on a farm near Richfield Springs, Otsego county, New York, and his abiding interest in farming pursuits has never been questioned. From an early age he was a diligent student, reading

HON. NORMAN J. COLMAN, ST. LOUIS, MO.

Mr. Colman has done more for the elevation of the farmers of this country than any other man living. He was the first Secretary of the United States Department of Agriculture, having been appointed to that position by President Cleveland when the department was made a cabinet position. He has been for many years a distinguished member of the Missouri Board of Agriculture, and has always taken an active interest in the proceedings of the Board. He was one of the foremost advocates for the establishment of a State Fair, and was the first President of the Fair Board, and is still a member of that body. Gov. Colman, through the columns of the Rural World, an agricultural journal which he established and has edited for more than fifty years, wields a powerful influence among the farmers, not only in Missouri, but throughout the entire country.

every volume in the common school library in his school district before the age of 16, and carrying on his other studies in his thoroughly characteristic manner. He worked his way through school by teaching in winter and attending the seminaries in the vicinity in summer, until twenty years of age, when his ambition to identify himself with the growing west influenced him to remove to Kentucky. Here he taught school in Louisville, and thus provided himself with means to attend the Louisville Law University, where he took the degree of Bachelor of Law, and later was licensed as an attorney. He practiced law at New Albany, Indiana, and was elected district attorney. In 1852 young Colman removed to St. Louis, continuing in the successful practice of his profession. His love for rural pursuits soon induced him to purchase a country home, and establish an agricultural journal, known as Colman's Rural World, now of national reputation as an influential exponent of the best methods in all that pertains to advanced agriculture.

He soon became a prominent leader and advocate of agricultural progress in the Mississippi valley. He was called upon to take an active part in every movement in behalf of the interests of the farmer, and soon became generally known as a forceful and eloquent advocate of better methods in farming and of State and National legislation needed to give the producer the full return for his labors.

His loyalty to his constituency and his unswerving devotion to the farmers' interest prompted the agricultural classes to secure him the following well-merited honors, viz.: A member of the Missouri Legislature, Lieutenant-Governor of his State, President of the Missouri State Horticultural Society, President of the Missouri State Board of Agriculture, trustee for fifteen years of the Missouri State University, President of the Missouri State Press Association for two terms, United States Commissioner of Agriculture, and when the United States Department of Agriculture was created, he was made the first secretary.

But few persons appreciate the magnitude of the work accomplished by Mr. Colman in behalf of our agricultural interests. It was more than a score of years ago that he took his seat as United States Commissioner of Agriculture, under the appointment of President Grover Cleveland. At that time the standing of the department was at a low ebb. It was the butt of ridicule of the Washington correspondents of the public press. The great interests it represented had no voice in the President's cabinet. Not a single government experiment station existed in connection with an agricultural college or university in the United States. Many of the most important and useful divisions now existing in the department had never been thought of, or at least established. At that time, also, that terrible and incurable disease of contagious pleuro pneumonia existed among our dairy herds and in cattle yards in various parts of the United States.

It was a critical period in the history of the department, and it needed a man of great administrative and executive ability to place it in that position which the great interests it represented entitled it to occupy.

Fortunately, the right man was found to take charge of it and place it on the high plane it should stand. Its elevation could be made only by slow degrees. Congress must furnish every dollar required to raise the quality of the work and expand it. Great diplomacy was necessary to secure the proper appropriations. It was only by showing Congress the value of the work being accomplished that new and increased appropriations could be secured.

Mr. Colman was well equipped for the important work to which he was assigned. For more than thirty years prior to his appointment he had been editor of the leading agricultural paper of the Mississippi valley. He had not only discussed with pen, but with tongue, the great problems that confronted the farmers, and that were identified with their interests. He was a forcible and eloquent speaker, and always held the rapt attention of his listeners. But few public meetings in his section were held where agricultural interests were considered, at which he was not one of the invited speakers. Having been born and brought up on a farm, and having been a practical, as well as theoretical farmer, all his life, he was in close touch and sympathy with his brother farmers. He knew their needs and also what was necessary to be done to secure them. He was well aware of the great prejudice existing against theoretical farming, or "book larnin'," as it is sometimes called, then existing, to a far greater extent than at the present day. He had had legislative experience, which was of much value in enabling him to deal with Congress, in order to secure proper appropriations to elevate the standard of the department. He had served as a member of the Legislature of his State, and also as Lieutenant-Governor, presiding over the Senate.

We have presented these facts in order to show how well equipped he was to fill the important position to which he had been elevated, and it was owing to this admirable equipment that his great success was attributable.

He repeatedly told us that in accepting the office, his highest ambition would be achieved, if he could secure government experiment stations, or experimental farms in connection with our agricultural colleges, so that practical and scientific agriculture could walk hand in hand, and thus obviate the prejudice which existed against scientific farming. The other object of his ambition was to make the department worthy of becoming one of the great executive departments of the government, with a voice in the President's cabinet, during his administration. By his wise administration of the office, both houses of Congress passed a bill almost unanimously, creating it one of the great executive departments of the government, and Mr. Colman had the distinguished honor of being appointed the first Secretary of Agriculture.

The bill establishing experiment stations in connection with our agricultural colleges was also passed, and the stations put into practical working order during his administration, so that both of the highest objects of his ambition were accomplished.

But it is much easier to tell of the achievements of these great objects than of the steps that had to be taken to secure them. And first, as to the establishment of experiment stations. Feeling that it was esential to achieve the co-operation and influence of the agricultural colleges in order to secure the passage of a bill through Congress to create them Mr. Colman, not long after taking his seat as Commissioner, issued a call to the agricultural colleges in every state of the Union, requesting them to send delegates to a convention to be held in the department building in Washington, July 8, 1885. This invitation was accepted, all the colleges sending delegates, forming what history will proclaim, on account of the great results achieved by it, one of the most important agricultural conventions ever held. By unanimous vote, Mr. Colman was chosen president of the convention, and that part of his address relating to experiment stations was referred to a special committee, to which Mr. Colman was afterward added, and that committee finally reported the Experiment Station Bill, which was afterwards passed by Congress and approved by the President, establishing experiment stations in every state in the Union. Mr. Colman thought by enlisting the co-operation and active work of each of the agricultural colleges in the different states on its own senators and representatives in Congress, such a bill could be passed, and the result was a justification of his judgment.

To secure the passage of a bill evoluting the department into one of the great executive departments of the government was a much more difficult task. Mr. Colman knew that this could only be accomplished by meriting such promotion. It must be made worthy of such advancement. It would take too much space to give a history of the work accomplished by him during his four years' term of service. We can only refer to a few of the many things secured under his administration.

The first matter that attracted his attention was the stamping out of that dread disease among our cattle, known as contagious pleuro pneumonia. It was found to exist in nearly twenty states of this Union. The disease is incurable, and the only way to extirpate it was to kill every affected animal and every animal that had been exposed to an affected one Whole herds had to be slaughtered. Of course, great opposition was raised to such action—but the heroic course was the only safe way to proceed. Millions of dollars were required to pay for slaughtered herds, but Congress freely made the proper appropriations, and this dread disease was practically eliminated from this country during his administration.

The great fruit growing interests of the nation had been overlooked by the department, and one of his first acts was to take them under consideration, and establish a division of Pomology to look after and encourage the interests of the fruit growers in all parts of the United States. It has become one of the leading divisions of the department.

Another of the important divisions established was that of Vegetable Pathology. Vegetable life is fully as subject to disease as animal life. Mildews, blights, rusts, smuts, moulds destroy millions of dollars' worth of crops annually, and to guard against them, and to give remedies for them, and to recommend such courses of cultivation as to avoid them, were the objects of Mr. Colman in starting this division.

The division of Ornithology and Mammalogy was also established by him in order to secure information as to which varieties of birds and smaller animals as gophers, moles, minks, skunks, field mice, etc., were friends, and which were enemies to the farmer and how their depredations might be prevented.

The division of the United States Experiment Stations was likewise established by him to take advantage of and utilize the vast fund of information to be secured at the various experiment stations of the different states of the Union, so as to make it available to those most needing it.

But it was not only in establishing new divisions, but in greatly extending the scope of those that existed that commended his work to Congress and to the active workers in the cause of agricultural progress. It was this great advancement that secured the confidence of the members of Congress and caused them to aid in the rapid elevation of the department.

It was, however, the establishment of the experiment stations throughout the states of the Union, and the elevation of the department as one of the great executive departments of the government, during his administration, and his appointment as the first Secretary of Agriculture, that Mr. Colman will be longest and most widely known and remembered. So highly was his work appreciated that the Republic of France, through its Minister of Agriculture, conferred on him la crosse de Officier du Merite Agricole, an honor which but few Americans have received. .

The University of Missouri, at its late commencement exercises, in recognition of his services to the cause of agriculture, conferred on him the honorary degree of LL. D. The Missouri State Horticultural Society, at its last session, created the office of Honorary Vice-President, and elected him to fill it for life, as a slight tribute for what he had done in behalf of Pomology. Such appreciation of his services during his lifetime cannot be otherwise than most agreeable to him.

The official life of Mr. Colman, referred to above, covers but a small portion of his useful services to the farmer and stockman. Even a brief reference to the helpful services rendered the farmers of the United States by him in all the departments of rural life would fill several volumes.

The man we meet to honor today has not only rendered efficient and acceptable services to the farmers of the United States in the various State and National positions he has been chosen with such hearty unanimity to fill, but he has made an enviable reputation in the private walks of life as a good farmer and a successful breeder of the best types of registered live stock.

This brief and hastily prepared sketch would be far from complete without some reference to his long and highly esteemed services as a director in various registration and other live stock organizations, State fairs, industrial expositions, world's fairs, etc., but the time at my command will not allow me to refer to them further.

The distinguished honor bestowed on Mr. Colman on this occasion, by the conferring of the degree of Doctor of Agriculture by the great University of Illinois, has been well earned, without taking into consideration the services incident to the various offices he has filled with so much credit and satisfaction to the interests represented.

His earnest and successful advocacy of the practice of the best methods in all that pertains to rural husbandry, contained in the weekly messages he has sent through Colman's Rural World to the progressive farmers of the Mississippi valley for more than half a century, is not the least of his great achievements.

His writings and speeches have made him a leader in the campaign of education he has so ably conducted, and his influence for good in encouraging the residents of the farm to obtain the best results in the growing of crops, breeding of live stock and perfecting the high standard of rural citizenship by the education of their sons and daughters, cannot be measured or overestimated. All the honors that have been conferred upon him have been most worthily bestowed, and particularly that of Doctor of Agriculture conferred by this University.

THE UNITED STATES GOVERNMENT ESTABLISHING AN AMERICAN BREED OF CARRIAGE HORSES.

The Premier Sire, a Missouri Horse, Bred by Hon. Norman J. Colman, First United States Secretary of Agriculture, and for Many Years a Distinguished Member Missouri State Board of Agriculture.

An essentially American breed of horses, bred primarily for carriage use, and general excellence of conformation, is the aim of the Department of Agriculture, and surprising progress in the establishment of such a breed has already been made. A small string of Morgan mares has been assembled, and a sire for the new breed has been selected. The sire is an inbred Hambletonian, Carmon 32917, American Trotting Horse Register, once exhibited by Thomas W. Lawson as Glorious Thundercloud.

"What the thoroughbred is to the Englishman, the trotting horse is to the American," said Dr. D. E. Salmon, chief of the Burean of Animal Industry. Taking this as his text, Dr. Salmon will describe the aims and accomplishmens of his bureau in this direction in the forthcoming yearbook of the Department of Agriculture.

"In the countries of the world where horse breeding has been encouraged by government assistance," says Dr. Salmon, "the foundation has been native stock, and the key to successful work has been selection according to a certain type. Furthermore, with all due respect to Godolphin Arabian, the Darley Arabian and their contemporaries, the great factor in developing the thoroughbred horse was the method of the English breeder, and more credit is due to native English stock and to environment than has generally been acknowledged. * * * The thoroughbred has been the great leavening power in developing English breeds of light horses; the trotter may bear the same relation to the horse stock of America.

"The trotter is found throughout the country wherever horses are raised, and any improvement in this breed affects in time the entire horse industry. The light market classes can be supplied from this source, and there is no more effective way to provide a supply of suitable cavalry horses for the United States army than by showing how the native horse may be improved.

FAULTS OF THE TROTTER.

"That the trotter has faults no one will deny, and that the speed idea has been responsible for many of these faults and has caused many a man to become bankrupt, are equally certain. If a horse can trot in 2:10 or better, it is reasonably certain that he will make money for his owner, and it matters not how homely or unsound he may be; but if the horse has bad looks and unsoundness, and also lacks speed, he will be unprofitable on the track, and cannot be sold at a profitable price on the market, while, if used in the stud, his undesirable qualities are perpetuated. On the other hand, if the horse has moderate speed, but is sound, handsome and stylish, with a shapely head and neck, a straight, strong back, straight croup, muscular quarters and stifles, well set legs, possesses good all-around true action, and has abundant endurance, he is almost certainly a profitable investment. This is the kind of light horse which the market wants and will pay for. If of the roadster type, he sells well as a driver; if more on the heavy harness order, as a carriage horse.

"The occurrence of trotting-bred horses of the finest conformation is by no means uncommon; it is so frequent indeed that these animals supply not only the demand for roadsters, but the principal part of the fine city trade in carriage horses, and are conspicuous winners at the horse shows. The demand for such horses has been so keen that dealers have resorted to the pernicious practice of buying mature stallions, many of them valuable breeders, and castrating them, to be sold later as carriage horses. The famous Lord Brilliant, three times winner of the Waldorf-Astoria gig cup at Madison Square Garden, is a notable instance of this practice; Lonzie, a noted Chicago show horse, is another, and the horse purchased for the department experiments (Carmon) narrowly escaped the same fate. This practice cannot be too strongly condemned. There is reason to believe that if these stallions were used as the nucleus of a breed the type would in time become fixed and their blood be saved to the country. On the other hand, if steps are not taken to mould the blood of these horses into one breed, and preserve the blood lines which produce them, an irreparable loss to the industry will result. The first step should be to select foundation stock strictly according to type; the next to study the lines of breeding which produce these horses. To a certain extent they are accidents of breeding, but there is little doubt that certain families show a greater tendency in this direction than others. For example, the descendants of Alexander's Abdallah, Harrison Chief, the Morgans and the Clay family have been more or less notable in this respect. Further, certain sires are known to produce handsome and marketable horses with regularity.

GOOD PROGRESS MADE.

"In view of these facts, the department decided to undertake the development of a breed of carriage horses on an American foundation as an interesting and important problem for solution. If successful, it will show that we can develop our own breeding stock of horses in this country; it will make light horse breeding less of a lottery than it is at present, and will at the same time provide breeding animals which can be used profitably on the lighter horses of the country.

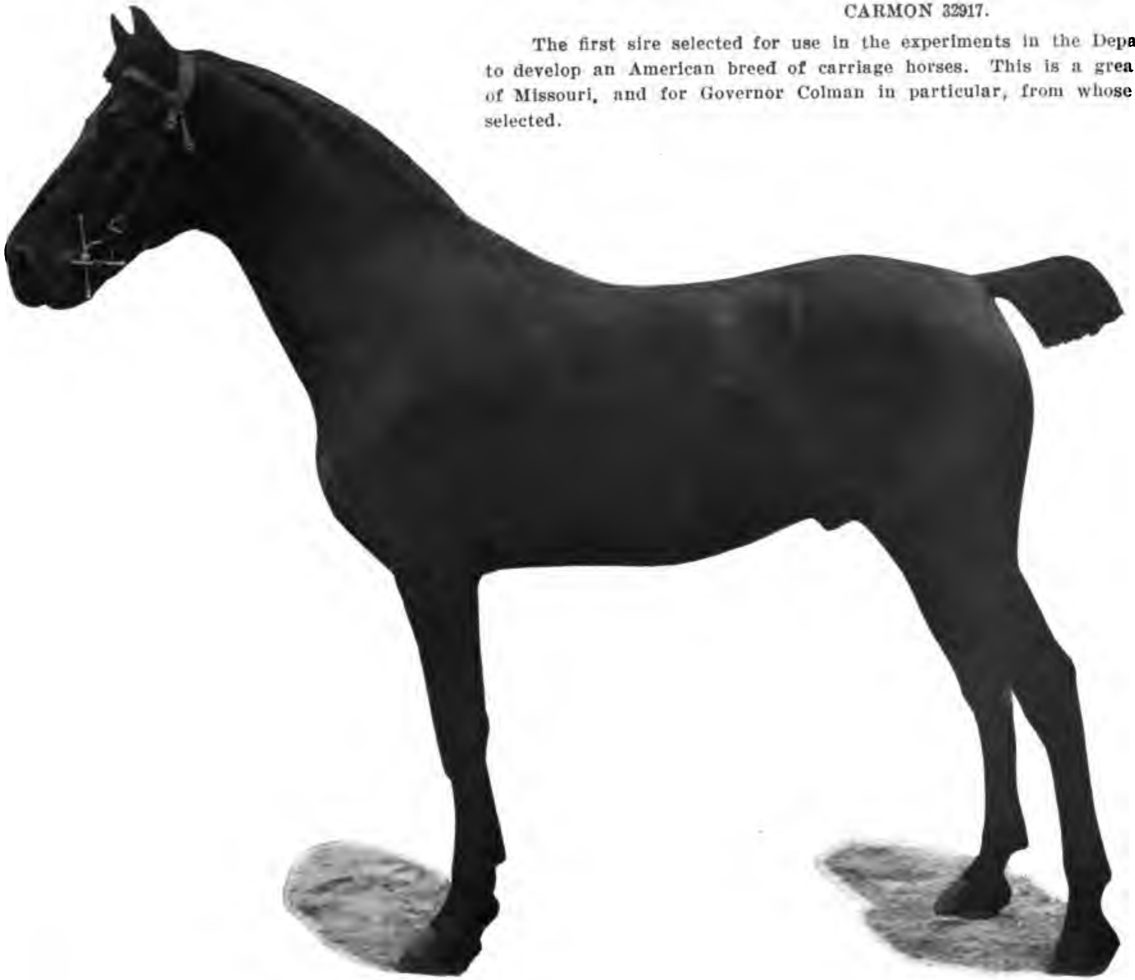
"After a thorough search, the department has purchased as foundation stock eighteen mares and one stallion. In addition, it can command the services of additional stallions, if desired. The instructions of the purchasing board allowed considerable latitude, but it was required to select strictly according to type. Heredity unsoundness was regarded as a disqualification. Pedigree was not considered, so far as registration was concerned, but the board required evidence to be submitted showing that the animals purchased were from parents and ancestors of like type, thus insuring blood lines that would breed reasonably true. Speed, while not ignored, was not made an essential. Life, spirit and energy, with moderate speed, were considered, while conformation and good action was regarded as an advantage.

"The type for mares was one standing about 15.3 hands, weighing 1,100 to 1,500 pounds, bay, brown or chestnut in color, with stylish head and neck, full made body, full croup, muscular forearms, quarters and lower thighs; good all-round action was insisted upon. Any tendency to pace or mix gaits were regarded as grounds for disqualification. In some cases, mares of more than 15.3 hands were purchased, and in others they were less than this. All, however, conformed closely to the type. Some of the mares are in foal; the rest will be bred this spring.

"The ancestors of six mares purchased in Wyoming have been bred for five or six generations in that state, the band having been started by means of an importation of horses from the central west, which was largely of Morgan stock. On this stock thoroughbred and standard sires have been used, and the herd has been developed more to produce a horse suitable for carriage purposes than one which had speed characteristics. Some of the six have been exhibited at the New York Horse Show, and the owner of the ranch maintains a stable near New York City, where he sends his surplus from year to year to be finished for the fine city trade.

THE SIRE, CARMON.

"The search for a stallion to head the stud was the most difficult of all. An almost unlimited number of trotting horses, suitable to get good carriage horses, were recommended to the department, but on investigation it would be found that they were deficient in some respect and could not be considered. A horse was finally selected, which was among the



CARMON 32917.

The first sire selected for use in the experiments in the Department of Agriculture to develop an American breed of carriage horses. This is a great honor for the State of Missouri, and for Governor Colman in particular, from whose farm this horse was selected.

first suggested—Carmon 32917, American Trotting Horse Register, 16 hands, weighing 1,200 pounds in fair condition, bay, with black points, and no white markings, bred by Hon. Norman J. Colman of St. Louis.

"The points of Carmon's conformation which deserve special mention are his head and neck and hindquarters. His forehead is broad and full, with a straight nose and face; full, expressive eyes and well carried ears. The neck is clean, muscular and well arched. The illustration does not do him justice in these respects. In the hindquarters special attention should be directed to the straight, broad croup and the muscular quarters and lower thighs. The horse has an abundance of bone and substance, but ample quality at the same time. His action is excellent.

"A study of Carmon's pedigree shows that it is not a particularly fashionable one from the standpoint of the man who is breeding solely for speed. This is a pedigree from which one might expect a horse of excellent conformation. Robert McGregor, for example, was a horse with especially well developed hindquarters, and this characteristic is seen in his sons and grandsons, as shown by Cresceus and Carmon. Abdellah XV. was a horse with a particularly attractive head and neck. The frequency with which the Abdallah cross appears in Carmon's pedigree and the presence of Morgan, Mambrino Chief and Clay blood readily explain where this horse gets his handsome head and neck and his full quarters and stifles. These families have produced some of our handsomest horses. Their blood makes up nineteen-sixty-fourths of Carmon's pedigree.

"The small percentage of pacing blood is worthy of particular notice. Further, the prominent trotting sires in it have produced more trotters than pacers, and Robert McGregor, Abdallah XV. and Ethan Allen are noteworthy for the small number of pacers sired by them or produced by their sons and daughters. This is so small that they may be regarded strictly as sires of trotters. Abdellah XV. and Ethan Allen sired no pacers, and of the immediate get of Robert McGregor less than 10 per cent are pacers.

"The horses purchased are on the farm of the Colorado Agricultural College. In the management of the stud the most rigid selection will be practiced, and no animals will be retained for breeding purposes that do not conform to a high standard."

AGRICULTURE AND LIVE STOCK STATISTICS.

CROP REVIEW, 1905.

Taken as a whole, the year 1905 was a very satisfactory year for the farmers of Missouri. The season started out admirably, but later excessive rains and destructive wind storms caused heavy damage to the crops and considerably reduced the flattering prospects of the earlier part of the season. Farm prices have been generally remunerative, and most of the farmers have been able to add a little during the year to their surplus bank account.

Corn.—Weather conditions during April, May and June were almost ideal for corn except in a few of the north central counties, and a reasonably good stand of corn was secured. The poor stand in most instances was caused by poor seed, and this emphasizes the great importance of planting seed of good germinating quality and strong vitality. It will be remembered that the season of 1904 was not good for maturing and drying out the seed corn. The general average condition for the State up to the middle of July promised a yield of about equal to the banner crop year of 1902, but excessive rains and wind storms during July and August reduced the prospects and damaged the crop to such an extent that the yield this year is the third largest in the history of the State, being exceeded by the crops of 1895 and 1902.

While a great deal of the corn is of good quality, a considerable portion of the crop was badly damaged by being blown down and the wet weather, causing it to rot. There was also considerable damage to corn that was put in the shock.

The acreage for 1905 is estimated at 7,076,050, compared with an acreage of 6,646,790 for 1904, or an increased acreage over 1904 of nearly 6 per cent.

Wheat.—The acreage sown to wheat in the fall of 1904 for the harvest of 1905, was 2,383,280. Approximately, 2 per cent of this acreage was plowed up and not harvested, leaving the estimated acreage harvested in 1905, 2,339,410. The yield for the entire State was about an average, and the quality generally good. However, in a number of the extreme southwestern counties the yield was very poor and the quality poor. The cause of the poor yield was on account of the heavy rains during the blooming season, which prevented perfect pollination.

The estimated acreage sown to wheat in the fall of 1905 for the harvest of 1906 is about 6 per cent below the acreage sown the previous year. The greatest decrease is in the southwest section, and is, no doubt, owing to two principal causes: First, owing to the very unsatisfactory yield in several of the large wheat counties of that section last year; and, second, because of the wet weather preventing the preparation of the soil for sowing. The condition of the new crop on the first of December was 90, which is above the normal condition for that time of year, and which is 17 points above the condition of the crop at the same time in 1904.

CORN, HAY AND FORAGE.

Table giving acreage, average yield per acre and total product of corn and hay and forage by counties for the year 1906:

	Corn.			*Hay and forage.	
	Acres planted.	Average yield per acre, bu.	Total yield per county, bu..	Acres.........	Total yield per county, tons.
State................................	7,076,050	33.6	245,152,245	3,456,057	3,562,446
County.					
Adair....................................	64,535	32	2,065,120	66,895	46 977
Audrain..................................	121,070	32	3,874,240	57,986	40,614
Andrew..................................	89,350	31	2,769,850	31,090	37,556
Atchison................................	168,425	42	7,073,850	22,320	43,668
Barry....................................	51,415	31	1,593,865	14,050	14,080
Barton...................................	95,755	30	2,872,650	59,590	71,515
Bates.....................................	143,240	32	4,583,680	78,600	81,900
Benton...................................	57,705	30	1,731,150	31,845	34,218
Bollinger................................	32,955	26	856,830	11,375	13,640
Boone....................................	88,535	39	3,452,865	48,775	29,333
Buchanan................................	64,130	36	2,308,680	21,055	31,628
Butler....................................	22,385	30	671,550	6,600	6,600
Caldwell.................................	86,040	35	3,011,400	45,165	67,778
Callaway................................	84,260	35	2,949,200	51,466	36,047
Camden..................................	32,400	30	972,000	11,575	9,383
Cape Girardeau........................	35,185	38	1,337,030	20,600	27,708
Carroll...................................	150,120	35	5,254,200	50,914	52,014
Carter....................................	10,755	28	301,140	2,332	27,852
Cass......................................	116,785	36	4,204,260	63,350	64,010
Cedar....................................	54,195	28	1,517,460	20,560	21,208
Chariton.................................	77,845	45	3,503,025	57,204	58,206
Christian................................	43,430	30	1,302,900	13,780	12,402
Clark.....................................	87,270	35	3,054,450	48,355	48,498
Clay......................................	68,815	39	2,683,785	20,490	30,738
Clinton..................................	94,435	40	3,777,400	37,260	48,504
Cole......................................	24,720	40	988,800	17,300	17,300
Cooper...................................	77,395	45	3,482,775	24,620	24,620
Crawford................................	28,915	32	925,280	13,000	13,000
Dade.....................................	65,800	28	1,842,400	19,010	19,613
Dallas...................................	44,325	30	1,329,750	19,430	19,545
Daviess.................................	104,635	33	3,452,955	57,325	69,154
DeKalb..................................	97,460	31	3,021,360	45,140	51,415
Dent.....................................	30,785	32	985,120	16,130	16,130
Douglas.................................	40,300	25	1,007,500	13,274	10,631
Dunklin.................................	43,085	40	1,723,400	5,066	6,566
Franklin.................................	49,305	41	2,021,505	24,010	28,810
Gasconade,.............................	21,880	40	875,200	13,510	11,018
Gentry...................................	90,660	33	2,991,780	55,880	73,660
Greene..................................	76,310	29	2,212,990	26,488	31,794
Grundy..................................	72,395	35	2,533.825	57,930	59,412
Harrison................................	127,375	37	4,712,875	81,331	106,054
Henry....................................	116,005	32	3,712,160	48,990	45,515
Hickory.................................	37,595	24	902,280	16,900	14,010
Holt......................................	95,515	32	3,056,480	13,875	174,625
Howard..................................	45,555	42	1,913,310	27,240	27,240
Howell...................................	43,870	26	1,140,620	13,270	10,675
Iron......................................	13,210	26	343,460	8,770	71,210
Jackson.................................	105,770	42	4,442,340	42,755	55,756
Jasper...................................	70,550	32	2,257,600	30,070	33,640
Jefferson...............................	41,740	36	1,502,640	20,170	26,212
Johnson.................................	114,120	39	4,450,680	56,170	51,033
Knox.....................................	63,340	31	1,963,540	59,190	47,717

CORN, HAY AND FORAGE—Continued.

	Corn.			*Hay and forage.	
	Acres planted.	Average yield per acre, bu.	Total yield per county, bu..	Acres..	Total yield per county, tons.
Laclede	36,165	28	1,012,620	24,220	24,280
Lafayette	116,770	44	5,137,880	35,234	42,346
Lawrence	58,040	30	1,741,200	14,560	15,010
Lewis	53,925	35	1,887,375	49,254	39,936
Lincoln	68,405	32	2,188,960	21,508	21.667
Linn	80,090	38	3,043,420	83,128	67,102
Livingston	93,740	40	3,749,600	53,930	60,963
McDonald	27,195	27	734,265	8,884	8,939
Macon	86,485	36	3,113,460	83,470	75,503
Madison	15,920	32	509,440	10,790	10,790
Maries	28,320	30	849,600	12,265	12,298
Marion	50,695	37	1,875,715	32,889	27,631
Mercer	61,710	37	2,283,270	59,435	71,644
Miller	33,595	31	1,041,445	16,670	16,690
Mississippi	38,285	30	1,148,550	4,565	5,459
Moniteau	42,800	38	1,326,400	25,600	25,650
Monroe	96,910	33	3,198,030	54,225	48,829
Montgomery	70,915	30	2,127,450	31,655	21,846
Morgan	37,455	37	1,385,835	24,590	22,773
New Madrid	40,080	30	1,202,400	2,790	3,834
Newton	42,410	29	1,229,890	22,260	25,638
Nodaway	233,835	38	8,885,730	61,454	92,676
Oregon	27,425	29	795,325	5,250	5,250
Osage	28,840	38	1,095,920	14,250	14,250
Ozark	31,505	24	756,120	3,670	3,670
Pemiscot	19,730	40	789,200	960	1,152
Perry	26,510	35	927,850	11,264	14,631
Pettis	103,195	40	4,127,800	51,703	63,826
Phelps	28,155	37	1,041,735	16,242	16,298
Pike	73,760	38	2,802,880	42,205	29,832
Platte	57,860	35	2,025,100	15,095	22,658
Polk	68,830	27	1,858,410	30,700	31,048
Pulaski	28,060	33	925,980	11,800	11,800
Putnam	57,375	31	1,778,625	68,570	68,813
Ralls	63,510	40	2,540,400	32,008	32,008
Randolph	56,570	40	2,262,800	21,974	19,971
Ray	115,050	40	4,602,000	44,980	45,712
Reynolds	14,405	30	432,150	8,760	8,760
Ripley	24,765	29	718,185	4,580	5,496
Saline	157,450	46	7,242,700	36,270	36,355
Schuyler	36,540	30	1,096,200	37,460	37,598
Scotland	56,935	35	1,992,725	51,900	52,041
Scott	35,460	38	1,347,480	7,250	7,250
Shannon	22,545	22	495,990	5,330	5,330
Shelby	73,450	40	2,938,000	54,525	38,563
Stoddard	52,605	28	1,472,940	8,065	9,675
Stone	31,085	30	932,550	7,536	7,539
St. Charles	43,165	40	1,726,600	17,104	17,195
St. Clair	73,800	28	2,006,400	33,840	34,830
St. Francois	19,700	25	492,500	15,150	15,150
Ste. Genevieve	17,090	30	512,700	9,260	11,106
St. Louis	38,395	45	1,727,775	32,085	33,291
Sullivan	68,305	33	2,254,065	95,500	86,470
Taney	27,280	28	763,840	3,545	3,545
Texas	50,015	24	1,200,360	25,215	20,175
Vernon	142,035	29	4,119,015	76,570	76,033
Warren	26,135	36	940,860	10,166	10,177
Washington	26,125	33	862,125	12,355	9,887
Wayne	27,605	30	828,150	11,900	11,900
Webster	41,350	22	909,700	21,940	22,033
Worth	51,035	35	1,786,925	27,240	40,980
Wright	34,985	25	874,625	19,482	19,587

*Includes both cultivated and wild hay. Previous estimates have been for cultivated hay only.

WHEAT AND OATS.

Table giving acreage, average yield per acre and total product of wheat and oats by counties for the year 1905:

	Wheat.			Oats.		
	Acres harvested..........	Average yield per acre, bu.	Total yield per county, bu..	Acres harvested..........	Average yield per acre, bu.	Total yield per county, bu..
State..	2,339,410	13	30,335,980	729,090	27.6	20,156,055
County.						
Adair..	2,120	17	36,040	3,550	23	81,650
Audrain..	1,185	17	20,145	27,275	30	818,250
Andrew..	4,920	20	98,400	6,490	29	188,210
Atchison..	5,850	25	146,250	22,995	28	643,860
Barry..	44,060	6	264,360	5,535	30	166,050
Barton..	12,425	11.5	142,890	12,200	22	268,400
Bates..	14,930	13.5	201,555	14,110	31	437,410
Benton..	12,365	14	173,110	9,290	27	250,830
Bollinger..	23,770	8	190,160	5,220	25	130,500
Boone..	21,290	15	318,350	7,805	28	218,540
Buchanan..	32,595	18	586,710	4,945	32	158,240
Butler..	1,895	10	18,950	1,340	24	32,160
Caldwell..	2,250	17	38,250	2,885	35	100,975
Callaway..	26,450	15	396,750	11,485	23	264,155
Camden..	7,175	10.5	75,335	2,990	26	77,740
Cape Girardeau..	63,305	6.5	411,465	7,305	30	219,150
Carroll..	20,640	20	412,800	7,600	30	228,000
Carter..	1,200	10	12,000	675	25	16,875
Cass..	18,750	14	262,500	11,370	30	341,000
Cedar..	13,165	13.5	177,730	8,300	23	190,900
Chariton..	24,265	18	436,770	5,000	27.5	137,500
Christian..	26,250	8	210,000	6,005	30	180,150
Clark..	7,080	18	127,440	22,875	35	800,625
Clay..	8,840	15	132,600	2,215	30	66,450
Clinton..	3,360	15	50,400	5,675	35	198,625
Cole..	36,330	19	690,270	4,205	27.5	115,640
Cooper..	59,730	16	955,680	7,945	30	238,350
Crawford..	15,320	9.5	145,540	2,495	25	62,375
Dade..	38,420	7	268,940	12,480	20	249,600
Dallas..	9,850	10	98,500	6,435	24	154,440
Daviess..	5,515	17	93,755	3,560	30	106,800
DeKalb..	1,820	17	30,940	3,975	28	111,300
Dent..	13,160	6	78,960	2,000	22.5	45,000
Douglas..	19,455	7	136,185	3,320	20	66,400
Dunklin..	4,125	17.5	72,190	1,040	22	22,880
Franklin..	85,860	12	1,030,320	7,585	28	212,380
Gasconade..	39,140	11	430,540	4,575	28	128,100
Gentry..	1,420	17	24,140	6,110	32	195,520
Greene..	57,325	9	515,925	14,675	30	440,250
Grundy..	2,820	17	47,940	2,705	30	81,150
Harrison..	2,240	19	42,560	8,465	32	270,880
Henry..	21,655	14.5	214,000	14,445	31.5	455,020
Hickory..	7,230	13.5	97,605	5,255	25	131,375
Holt..	7,930	24	190,320	14,620	32.5	475,150
Howard..	42,955	18	773,190	2,405	35	84,175
Howell..	28,190	6	139,140	3,980	28	111,440
Iron..	2,125	10	21,250	1,170	20	23,400
Jackson..	24,280	17.5	424,900	5,865	33.3	195,500
Jasper..	67,210	11	739,310	15,310	22.5	344,475
Jefferson..	28,720	13	373,360	2,740	23	63,020
Johnson..	59,760	16.5	986,040	9,690	32.5	314,925
Knox..	2,120	14	29,680	5,175	30	155,250

WHEAT AND OATS—Continued.

	Wheat.			Oats.		
	Acres harvested...	Average yield per acre, bu.	Total yield per county, bu..	Acres harvested.........	Average yield per acre, bu.	Total yield per county, bu..
Laclede	10,275	10	102,750	4,910	21	103,110
Lafayette	52,770	18	949,860	12,825	33.3	427,500
Lawrence	76,245	12	914,940	14,970	30	449,100
Lewis	7,490	14	104,860	6,395	25	159,875
Lincoln	45,860	16	733,760	14,575	25	364,375
Linn	3,960	18	71,280	4,055	33	133,815
Livingston	7,405	18	133,290	3,925	30	117,750
McDonald	17,470	9	157,230	2,050	30	61,500
Macon	5,430	16	86,880	3,055	35	106,925
Madison	8,030	13	104,390	1,345	21	28,245
Maries	13,305	9	119,745	3,030	24	72,720
Marion	17,900	16.5	295,350	3,905	28	109,340
Mercer	1,490	18	26,820	4,470	25	111,750
Miller	15,790	12	189,480	3,885	30	116,550
Mississippi	37,655	12	451,860	175	32	5,600
Moniteau	29,530	13	383,890	8,760	25	219,000
Monroe	7,995	14	111,930	10,505	23	241,615
Montgomery	19,225	16	307,600	16,295	20	325,900
Morgan	12,510	15	187,650	6,900	30	207,000
New Madrid	17,735	12	212,820	280	24	6,720
Newton	45,450	8.5	386,325	7,210	22.5	162,225
Nodaway	5,520	22.5	124,200	25,680	30	770,400
Oregon	10,310	7	72,170	2,960	20	59,200
Osage	40,150	15	602,250	2,665	30	79,950
Ozark	8,750	4	35,000	1,720	25	43,000
Pemiscot	5,220	12	62,640	65	24	1,560
Perry	52,015	12.5	650,190	5,220	28	146,160
Pettis	27,940	17.5	488,950	8,120	31	251,720
Phelps	10,440	10	104,400	3,905	30	117,150
Pike	45,740	14	640,360	12,750	22	280,500
Platte	44,280	19	841,320	3,095	35	108,325
Polk	26,970	10	269,700	11,575	22.5	260,440
Pulaski	7,465	9	67,185	2,175	25	54,375
Putnam	1,580	20	31,600	5,430	34	184,620
Ralls	12,285	16	196,560	7,445	20	148,900
Randolph	2,950	15	44,250	3,255	25	81,375
Ray	13,835	19	262,865	2,660	30	79,800
Reynolds	2,450	11	26,950	790	18	14,220
Ripley	4,540	6	27,240	3,290	20	65,800
St. Charles	76,135	21	1,598,835	9,180	30	275,400
St. Clair	8,150	11	89,650	8,815	24	211,560
Ste. Genevieve	31,850	12	382,200	1,585	25	39,625
St. Francois	15,060	10	150,600	1,910	18	34,380
St. Louis	53,940	13	701,220	2,915	28	81,620
Saline	57,580	17	978,860	6,980	30	209,400
Schuyler	2,560	15.5	39,680	4,355	30	136,050
Scotland	1,360	16	21,760	10,225	33	337,425
Scott	55,285	8.5	469,925	290	25	7,250
Shannon	3,195	3	9,585	915	20	18,300
Shelby	13,875	14	194,250	7,700	30	231,000
Stoddard	24,360	8.5	207,060	2,425	27	65,475
Stone	9,155	7.5	68,665	1,650	26	42,900
Sullivan	835	17	14,195	2,530	32.5	82,225
Taney	5,785	5.5	31,820	1,925	26	50,050
Texas	19,825	7.5	148,690	3,490	18	62,820
Vernon	11,750	11.5	135,125	10,600	25	265,000
Warren	28,130	14	393,820	9,410	21	197,610
Washington	16,475	11	181,225	2,315	20	46,300
Wayne	7,290	6.5	47,385	1,755	22	38,610
Webster	20,530	7.5	153,975	7,085	24	170,040
Worth	1,030	22	22,660	3,755	33.3	125,165
Wright	13,455	9	121,095	3,500	24	84,000

SUMMARY OF THE ACREAGE, YIELD AND VALUE OF FARM CROPS FOR THE YEAR 1905 FOR THE STATE AND BY SECTIONS.

CORN.

Section.	Acres planted.	Average yield per acre, bu.	Total yield bushels.	Total value.
Northeast	1,342,815	34.6	46,462,115	$17,196,410
Northwest	2,145,145	36.6	79,561,185	27,430,736
Central	1,150,940	36	43,537,890	15,808,322
Southwest	1,566,420	29	47,544,160	15,999,624
Southeast	870,730	31.9	28,046,895	10,526,263
State	7,076,050	33.6	245,152,245	$86,961,355

WHEAT.

Section.	Acres sown.	Acres harvested.	Average yield per acre, bu.	Total yield bushels.	Total value.
Northeast	303,460	302,865	16.7	5,056,025	$4,094,637
Northwest	251,295	250,810	18.7	4,680,980	3,686,393
Central	478,875	475,575	15.3	7,284,970	5,758,898
Southwest	657,545	637,115	10.2	6,482,960	5,015,279
Southeast	692,105	673,045	10.1	5,831,045	5,435,758
State	2,383,280	2,339,410	13	30,335,980	$23,990,965

WHEAT SOWN, FALL 1905.

Section.	Acreage sown, 1905.	Acreage compared with prev. year, %	Average condition crop, Dec. 1, 1905.	Previous five-year average con. Dec. 1, 1905.
Northeast	297,920	93	95	89
Northwest	245,265	98	95	93
Central	451,355	94	87	88
Southwest	580,895	88	88	84
Southeast	663,975	96	88	87
State	2,239,410	94	90	88

OATS.

Section.	Acres harvested.	Average yield per acre, bu.	Total yield bushels.	Total value.
Northeast	186,685	27.6	5,165,950	$1,368,360
Northwest	154,615	30.7	4,761,350	1,347,197
Central	117,400	27	3,185,095	957,130
Southwest	198,540	26	5,254,495	1,456,809
Southeast	71,850	25	1,789,165	615,351
State	729,090	27.6	20,156,055	$5,744,849

*HAY AND FORAGE.

Section.	Acres harvested.	Average yield per acre, ton.	Total yield tons.	Total value.
Northeast	997,893	.85	859,019	$5,723,123
Northwest	879,903	1.2	1,114,606	6,311,000
Central	561,939	.95	533,892	4,532,321
Southwest	686,919	1	706,183	4,497,151
Southeast	329,403	1	348,796	3,465,016
State	3,456,057	1	3,562,446	$24,528,611

FLAX.

Section.	Acres sown.	Average yield per acre, bu.	Total yield.	Total value.
Northeast	382	7	2,673	$2,459
Northwest	550	11	6,050	5,566
Central	1,826	8	14,610	13,295
Southwest	17,472	7	122,304	111,296
Southeast	....	....	....	....
State	20,230	7.2	145,637	$132,616

RYE.

Section.	Acres sown.	Average yield per acre, bu.	Total yield bushels.	Total value.
Northeast	4,200	13	54,600	$31,668
Northwest	7,700	17	130,900	73,304
Central	1,650	18	29,700	18,414
Southwest	2,400	10	24,000	15,600
Southeast	3,005	11	33,065	23,799
State	18,955	14.4	272,255	$162,785

BUCKWHEAT.

Section.	Acres sown.	Average yield per acre, bu.	Total yield bushels.	Total value.
Northeast	1,055	13	13,715	$10,286
Northwest	488	17	8,296	6,222
Central	123	12	1,476	1,107
Southwest	495	14	6,930	5,197
Southeast	40	14	560	420
State	2,201	14	30,977	$22,232

BARLEY.

Section.	Acres sown.	Average yield per acre, bu.	Total yield bushels.	Total value.
Northeast	130	19	2,470	$1,457
Northwest	1,203	22.5	27,067	13,533
Central	130	22	2,860	1,716
Southwest	215	23	4,945	2,967
Southeast	352	23	8,096	4,857
State	2,030	22.3	45,438	$24,530

*Includes cultivated and wild hay.

BROOM CORN.

Section.	Acres sown.	Average yield per acre, lbs.	Total yield, pounds.	Total value.
Northeast	473	366	173,118	$5,626
Northwest	483	400	193,200	6,038
Central	773	325	251,225	9,421
Southwest	3,367	425	1,430,975	48,652
Southeast	170	318	54,060	1,838
State	5,266	399	2,102,578	$71,575

COTTON.

Section.	Acres sown.	Average yield per acre, lbs.	Total yield, pounds.	Total value.
Northeast				
Northwest				
Central				
Southwest	5,403	250	1,350,750	$135,075
Southeast	60,524	290	17,551,960	1,913,164
State	65,927	287	18,902,710	$2,048,239

TOBACCO.

Section.	Acreage 1905.	Average yield per acre, lbs.	Total yield, pounds.	Total value.
Northeast	600	781	468,600	$46,860
Northwest	606	925	560,550	56,055
Central	1,050	1,036	1,087,800	119,658
Southwest	525	700	367,500	36,750
Southeast	654	750	490,500	53,955
State	3,435	866	2,974,950	$313,278

POTATOES.

Section.	Acreage 1905.	Average yield per acre, bu.	Total yield, bu.	Total value.
Northeast	13,301	85	1,130,585	$667,045
Northwest	20,751	82	1,701,582	901,838
Central	12,127	90	1,091,430	589,372
Southwest	15,132	84	1,271,088	559,278
Southeast	20,939	81	1,696,059	797,147
State	82,250	83.9	6,890,744	$3,514,680

SUMMARY OF TOTAL YIELD AND TOTAL VALUE OF FARM CROPS PRODUCED BY MISSOURI FARMERS IN THE YEAR 1905.

	Acreage.	Yield.	Total farm value.
Corn	7,076,050	245,152,245	$86,961,356
Wheat	2,339,410	30,395,980	23,990,965
Oats	729,090	20,156,055	5,744,849
Hay (tame and wild)	3,456,057	3,562,446	24,528,611
Flax	20,230	145,637	132,616
Rye	18,955	272,255	162,785
Buckwheat	2,201	30,977	22,232
Barley	2,030	45,438	24,530
Broom corn	5,266	2,102,578	71,575
Cotton	65,927	18,902,710	2,048,239
Potatoes	82,250	6,890,744	3,514,680
Tobacco	3,435	2,974,950	313,278
Sorghum syrup	*32,000	2,931,200	1,099,200
Sorghum seed	*32,000	768,000	499,200
Clover seed	36,000	64,800	395,280
Timothy and other grass seeds	55,000	212,280	342,176
Kaffir corn, millet, cowpeas, castor beans, etc.			1,150,000
Miscellaneous vegetables			6,500,000
Total value of all crops			$157,501,572

*Same acreage for both syrup and seed.

CROP YIELDS, 1905.

AVERAGE PER ACRE BY CROP SECTIONS.

Crop.	N. E. Sec. 20 counties.	N. W. Sec. 21 counties.	Central Sec. 21 counties.	S. W. Sec. 23 counties.	S. E. Sec. 29 counties.	Whole State, 114 counties.
Corn, bushels	34.6	36.6	36	29	31.9	33.6
Wheat, "	16.7	18.7	15.3	10.3	10.1	13
Oats, "	27.6	30.7	27	26	25	27.6
Timothy, tons	.85	1.2	.95	1	1	1
Prairie hay, "	1.3	1.6	1.3	1.2	1.2	1.3
Hay Clover, "	1.6	1.6	1.3	1.5	1.3	1.4
Cowpeas, "	1.5	1.6	1.6	1.4	1.8	1.5
Alfalfa hay, "	2.5	2.8	2.3	2.3	2.3	2.5
Flax, bushels	7	11	8	7	....	7.2
Rye, "	13	17	18	10	11	14.4
Buckwheat, bushels	13	17	12	14	14	14
Barley, "	19	22.5	22	23	23	22.3
Broom-corn, pounds	366	400	325	425	318	399
Cotton, (Lint)	....	....	....	250	290	287
Potatoes, bushels	85	82	90	84	81	83.9
Tobacco, pounds	781	925	1,036	700	750	866
Sorghum syrup, gallons	87	85	101	91	94	92.2
Sorghum seed, bushels	26	24	22	24	25	24
Kaffir corn, bushels	26	26	25	27	20	25
Cowpeas, "	9	8	8.5	15	13	10.7
Clover seed, "	2.4	1.7	1.7	1.9	1.6	1.8
Timothy seed, "	3.3	3.6	4	3.6	4	3.7

AVERAGE FARM PRICE, NOVEMBER 1, 1905.

The prices given in this table are governed by local conditions, and are the current local prices prevailing in the country.

	N. E.	N. W.	Central	S. W.	S. E.	State.
Corn, per bushel	$ .37	$ .347	$ .37	$ .34	$ .41	$ .367
Wheat, "	.795	.77	.786	.768	.786	.79
Oats, "	.27	.287	.30	.285	.347	.297
Flax, "	.92	1.00	.91	.91	....	.91
Timothy seed, per bushel	1.60	1.50	2.10	1.70	1.80	1.74
Clover seed, "	6.40	6.40	6.50	6.00	5.85	6.10
Cowpea seed, "	1.30	1.80	2.00	1.20	1.00	1.46
Sorghum seed, "	.75	.60	.60	.49	.80	.65
Kaffir corn, "	.65	.50	.66	.52	....	.58
Rye, "	.58	.56	.62	.65	.70	.60
Buckwheat, "	.61	.75	.75	.75	.75	.72
Barley, "	.42	.46	.60	....	.60	.54
Potatoes, "	.59	.53	.54	.44	.47	.51
Sweet potatoes, "	.89	.95	.67	.55	.55	.72
Winter apples, "	.91	.72	.80	.82	.89	.83
Timothy hay, per ton	7.00	5.90	8.60	7.00	9.80	7.60
Clover hay, "	7.00	5.60	8.60	6.50	8.90	7.30
Broom-corn, "	66.00	62.00	74.00	62.00	62.00	68.00
Cotton (Lint.), per pound	....	....	....	.10	.105	.103
Leaf tobacco, "	.10	.10	.11	.10	.11	.105
Wool, "	.27	.26	.26	.24	.24	.254

LIVE STOCK—AVERAGE FARM PRICE PER HEAD, DECEMBER 1, 1905.

	N. E. Section.	N. W. Section.	Central Section.	S. W. Section.	S. E. Section.	State.
Horses.						
Spring colts	$40.	$41.	$42.	$37.	$37.	$39.
Yearlings	60.	62.	58.	53.	55.	58.
Two years and over	88.	87.	80.	76.	80.	82.
Mules.						
Spring colts	54.	56.	55.	50.	46.	52.
Yearlings	66.	78.	74.	71.	66.	71.
Two years and over	107.	112.	103.	96.	93.	102.
Cattle.						
Steer calves	12.	12.	10.	8.	6.9	9.8
Heifer calves	9.9	9.6	8.2	6.	6.	7.9
Yearling steers	21.5	20.	17.	14.	11.	14.7
Yearling heifers	18.	16.	13.	11.	9.8	13.6
Steers, two and over	30.	30.	25.	23.	18.	25.2
Cows, two and over	23.	27.	21.	18.	16.	21.
Sheep.						
Lambs under one year	3.8	3.8	3.7	3.	2.8	3.4
All other sheep	4.9	4.	4.4	3.5	3.1	3.9
Chickens.						
Average price per pound	.08	.08	.07	.07	.07	.074
Turkeys.						
Average price per pound	.12	.11	.10	.10	.10	.106

LIVE STOCK—CONDITION AS TO THRIFT AND HEALTH, DECEMBER 1, 1905.

	N. E.	N. W.	Central.	S. W.	S. E.	State.
Cattle	94	99	98	96	96	97
Horses	100	100	98	98	95	98
Mules	100	99	98	99	96	98
Hogs	98	95	94	94	86	93
Sheep	96	98	94	95	95	96

ANNUAL REPORT OF DR. D. F. LUCKEY, STATE VETERINARIAN FOR THE YEAR, DEC. 19, 1904, TO DEC. 19, 1905.

Owner.	Postoffice.	How called.	Date.	Kind of stock.	Disease.	How disposed of.
Taylor Myers	Goldberry, Mo	Petition	1905. Feb. 26	6 cattle	Oesophagostomiasis	Sent Aug., 1904, bulletin
Richard Seamons	Goldberry, Mo	"	26	5 "	"	" " "
D. J. Roots	Effie, Mo	Personal request	March 2	6 "	"	Gasoline
N. E. Mosher	Salisbury, Mo	Petition	6	"	Supposed tuberculosis.	Tuberculin test
J. Scantlin	Salisbury, Mo	G. P. Dameron, Mayor	20	2 horses	Glanders	Dead
H. T. Gerdeman	Pendleton, Mo	Petition,	April 3	1 horse	Nasal gleet	Advised operation
E. E. Swink	Farmington, Mo	Dr. H.J. Sebaugh	19	2 mules; 1 horse	Glanders	Quarantined
J. M. Brown	Centralia, Mo	Message, Dr. Hampton	May 11.	7 cows	Poisoning	Given epsom salts
Albert Maiden	Sturgeon, Mo	Petition	16	2 horses	Scabies	Sulphur & lard or linseed oil.
T. A. Sims	Sturgeon, Rt. 3, Mo	"	16	3 "	"	" " "
G. W. White	" "	"	16	2 "	"	" " "
J. M. Brown	Centralia, Mo	Return visit	22	2 cows	Lead poisoning	Dead
Fred Robb	Higbee, Mo	Letter	24	1 horse	Nasal gleet	Operation to drain sinus
Jasper Harrison	St. James, Mo	Message	28	6 cattle	Epizootic aptha	Chlorate of potassium gargle and purgation epsom salts
Jasper Wilkison	Conway, Mo	Telegram	28	4 cows; 20 dead	Oesophagostomiasis	Dead
Rice & Lockridge	Mexico, Mo	U.S. Stock Yards Inspector	30	132 sheep	Scabies	Quarantined
O. B. Dorsey & A. J. Watkins	Lawson, Mo	Letter	June 13	120 cattle	Tuberculosis	" Tuberculin test.
S. G. Huffman	Sturgeon, Mo	U.S. Stock Yards Inspector	7	80 sheep		Found to be healthy
Samuel Powers	Mandeville, Mo	Petition	July 1	1 horse	Nasal gleet	Operation
J. B. Lanten	5514 Magnolia Av., St. Louis	Letter	June 30	1 "	Glanders	Quarantined
Mrs. Anna McNutt	Clinton, Mo	Letter, Dr. Klutz	Aug. 21	22 cattle	Texas fever	"
Louis Schrimpf	R. 5, Webster Groves.	Tel., Dr. Krumrey	31	1 mule	Glanders	"
Daniel Sisco	6448 Manchester Av., St. L.	Letter, Dr. J. W. Crowder	Sept. 25	1 "	"	"
A. C. Koch	6900 " " "	Letter, Dr. H. J. Henrickson	Oct. 2	1 horse	"	Had been destroyed
James Cronin	12th and Walnut, St. Louis.	Letter, Dr. C. W. Crowley	Sept. 27	1 "	"	Had been taken away
E. H. Brickers	Ore, Mo	Petition	20	1 cow	Tuberculosis	Killed
John Marks	R. 3, Farmington, Mo	Letter, Dr. H. J. Sebaugh	Oct. 15	1 mule	Glanders	Quarantined
Chas. Wolfsberger	Old Orchard, Mo	Letter, Dr. W. R. Harrison	Oct. 23	1 mule	Glanders	Dead
F. H. Walters	" "	Letter, Dr. W. R. Harrison	23	1 bay mare	"	Quarantined
Wm. Medley	" "	Letter, Dr. W. R. Harrison	23	1 bay gelding	"	"

ANNUAL REPORT OF DR. D. F. LUCKEY, STATE VETERINARIAN (FOR YEAR, DECEMBER 19, 1904, TO DECEMBER 19, 1905)—Continued.

Owner.	Postoffice.	How called.	Date.	Kind of stock.	Disease.	How disposed of.
			1905.			
G. F. Lindhorst	Webster Groves, Mo	Letter, Dr. W. R. Harrison	Nov. 4	1 horse	Gleet	Referred case to Dr. Harrison
Peter Gormely	Rt. 6, Old Orchard, Mo.	Letter, Dr. W. R. Harrison	4	1 mule	Glanders	Quarantined
Wm. Medley	Old Orchard	Letter, Dr. W. R. Harrison	5	2 horses	"	"
Franke Blaske	New Haven, Mo	Letter	6	hogs	Cholera	Isolation and burning of carcasses
Geo. P. Morton	Eminence, Mo	Petition	14	12 cattle	Strongylus contortus	Gasoline
J. R. Matthews	Chillicothe, Mo	Letter	24	4 horses	Gleet	Isolation to hold for observation
J. T. Taylor	Sikeston, Mo	Letter, Dr. D. E. Sawyer	28	6 cattle	Indigestion	Dead
J. E. Pearman	" "	Letter, Dr. D. E. Sawyer	28	5 cattle	"	"
Steve Gettemiers	Anglum, Mo	Telegram, Dr. Stahl	Dec. 3	1 mule	Glanders	Quarantined
Ed Enos	St. Charles, Mo	Telegram, Dr. Stahl	11	1 horse	Gleet	Removal of ulcerated tooth.

NOTE.—This table shows only the control work done by the State Veterinarian during the year. A part of his time is taken up in office duties, lecturing at farmers' institutes, preparing the annual veterinary bulletin, investigations, etc. of which no mention is made in this table.

ANNUAL REPORT OF DR. D. F. LUCKEY, STATE VETERINARIAN FOR THE YEAR, DEC. 19, 1904, TO DEC. 19, 1905.

Owner.	Postoffice.	How called.	Date.	Kind of stock.	Disease.	How disposed of.
Taylor Myers	Goldberry, Mo	Petition	1905. Feb. 26	6 cattle	Oesophagostomiasis	Sent Aug., 1904, bulletin
Richard Seamons	Goldberry, Mo	"	26	5 "	"	" " "
D. J. Roots	Effie, Mo	Personal request	March 2	6 "	"	Gasoline
N. E. Mosher	Salisbury, Mo	Petition	6	"	Supposed tuberculosis.	Tuberculin test
J. Scantlin	Salisbury, Mo	G. P. Dameron, Mayor	20	2 horses	Glanders	Dead
H. T. Gerdeman	Pendleton, Mo	Petition	April 3	1 horse	Nasal gleet	Advised operation
E. E. Swink	Farmington, Mo	Dr. H. J. Sebaugh	19	2 mules; 1 horse	Glanders	Quarantined
J. M. Brown	Centralia, Mo	Message, Dr. Hampton	May 11.	7 cows	Poisoning	Given epsom salts
Albert Maiden	Sturgeon, Mo	Petition	16	2 horses	Scabies	Sulphur & lard or linseed oil.
T. A. Sims	Sturgeon, Rt. 3, Mo	"	16	3 "	"	" " "
G. W. White	" "	"	16	2 "	"	" " "
J. M. Brown	Centralia, Mo	Return visit	22	2 cows	Lead poisoning	Dead
Fred Robb	Higbee, Mo	Letter	24	1 horse	Nasal gleet	Operation to drain sinus
Jasper Harrison	St. James, Mo	Message	28	6 cattle	Epizootic aptha	Chlorate of potassium gargle and purgation epsom salts
Jasper Wilkison	Conway, Mo	Telegram	28	4 cows; 20 dead	Oesophagostomiasis	Dead
Rice & Lockridge	Mexico, Mo	U.S. Stock Yards Inspector	30	132 sheep	Scabies	Quarantined
C. B. Dorsey & A. J. Watkins	Lawson, Mo	Letter	June 13	120 cattle	Tuberculosis	" Tuberculin test.
S. G. Huffman	Sturgeon, Mo.	U.S. Stock Yards Inspector	7	80 sheep		Found to be healthy
Samuel Powers	Mandeville, Mo	Petition	July 1	1 horse	Nasal gleet	Operation
J. B. Lanten	5514 Magnolia Av., St. Louis	Letter	June 30	1 "	Glanders	Quarantined
Mrs. Anna McNutt	Clinton, Mo	Letter, Dr. Klutz	Aug. 21	22 cattle	Texas fever	"
Louis Schrimpf	R. 5, Webster Groves.	Tel., Dr. Krumrey	31	1 mule	Glanders	"
Daniel Sisco	6448 Manchester Av., St. L.	Letter, Dr. J. W. Crowder	Sept. 25	1 "	"	"
A. C. Koch	6900 " " "	Letter, Dr. H. J. Henrickson	Oct. 2	1 horse	"	Had been destroyed
James Cronin	12th and Walnut, St. Louis.	Letter, Dr. C. W. Crowley	Sept. 27	1 "	"	Had been taken away
E. H. Brickers	Ore, Mo	Petition	20	1 cow	Tuberculosis	Killed
John Marks	R. 3, Farmington, Mo	Letter, Dr. H. J. Sebaugh	Oct. 15	1 mule	Glanders	Quarantined
Chas. Wolfsberger	Old Orchard, Mo	Letter, Dr. W. R. Harrison	Oct. 23	1 mule	Glanders	Dead
F. H. Walters	" "	Letter, Dr. W. R. Harrison	23	1 bay mare	"	Quarantined
Wm. Medley	" "	Letter, Dr. W. R. Harrison	23	1 bay gelding	"	"

ANNUAL REPORT OF DR. D. F. LUCKEY, STATE VETERINARIAN (FOR YEAR, DECEMBER 19, 1904, TO DECEMBER 19, 1905)—Continued.

Owner.	Postoffice.	How called.	Date.	Kind of stock.	Disease.	How disposed of.
			1905.			
G. F. Lindhorst	Webster Groves, Mo	Letter, Dr. W. R. Harrison	Nov. 4	1 horse	Gleet	Referred case to Dr. Harrison
Peter Gormely	Rt. 6, Old Orchard, Mo	Letter, Dr. W. R. Harrison	4	1 mule	Glanders	Quarantined
Wm. Medley	Old Orchard	Letter, Dr. W. R. Harrison	5	2 horses	"	"
Franke Blaske	New Haven, Mo	Letter	6	hogs	Cholera	Isolation and burning of carcasses
Geo. P. Morton	Eminence, Mo	Petition	14	12 cattle	Strongylus contortus	Gasoline
J. R. Matthews	Chillicothe, Mo	Letter	24	4 horses	Gleet	Isolation to hold for observation
J. T. Taylor	Sikeston, Mo	Letter, Dr. D. E. Sawyer	28	6 cattle	Indigestion	Dead
J. E. Pearman	" "	Letter, Dr. D. E. Sawyer	28	5 cattle	"	"
Steve Gettemiers	Anglum, Mo	Telegram, Dr. Stahl	Dec. 3	1 mule	Glanders	Quarantined
Ed Enos	St. Charles, Mo	Telegram, Dr. Stahl	11	1 horse	Gleet	Removal of ulcerated tooth.

NOTE.—This table shows only the control work done by the State Veterinarian during the year. A part of his time is taken up in office duties, lecturing at farmers' institutes, preparing the annual veterinary bulletin, investigations, etc. of which no mention is made in this table.

ANNUAL REPORT OF DR. R. C. MOORE, DEPUTY STATE VETERINARIAN, YEAR BEGINNING DECEMBER 19, 1904; ENDING DECEMBER 19, 1905.

Owner.	Postoffice.	How called.	Date.	Kind of stock.	Disease.	How disposed of.
Jerry Barnes	2540 Prospect Ave., Kan. City		1905. Jan. 4	1 horse	Chronic catarrh	
Jerry Barnes	" " "	Humane officer.	4	"	" "	
Thompson Transfer Co.	1309 W. 9th St. "	Owner	17	"	Chronic glanders.	Destroyed
W. J. Welsh	1026 Norton Ave., "	"	27	"	" "	Quarantined and reported to county court
	Leeds, Mo	State Veterin'n.	24	Sheep	Supposed scab	Not found.
Joseph Knox.	1603 Lydia Ave., Kansas City	Owner	27	1 horse	Chronic glanders	Quarantined and reported to county court
W. H. Woods	1028 Norton Ave., "	"	Feb. 14	"	Maxilitis	
	Mo. Pacific freight depot, Kansas City	Humane officer.	16	"	Nasal catarrh	
A. M. Cole	Washington Park, Mo	Owner	22	"	Ulcerative melanosis	
Lemp Brewing Co.	2002 McGee St., Kan. City	Dr. Getchell	March 4	"	Chronic glanders	
John Bowen	1611 Waldron Ave., "	Owner	6	"	" "	Quarantined and reported to county court
G. H. Bodon	1614 Tracy Ave., "		7	2 horses	Suspected glanders	Mallein test.
Fred. Wise	2129 Terrace St., "	Dr. Hill	21	1 mule	Chronic "	Quarantined and reported to county court
G. A. Ennis	124 Park Ave., "	Owner	April 1	1 horse	Purpura hemorrhagica	
P. Lafferty	1200 W. 24th St., "	"	1	"	Chronic glanders	
J. W. Hickman	1816 Euclid Ave., "	"	7	"	" "	
W. W. Hapgood	1904 Flora Ave., "		13	"	" "	Quarantined and reported to county court
Mr. Hildebrant	48th and Br'dway, "	S R. Ingram	15	"	Injury to leg	
Mr. Ackley	27th and Highland, "	Mr. Hamilton	15	"	Gangrenous pneumonia	
C. T. Collins	1223 E. 18th St., "	Owner	16	"	Chronic glanders	Quarantined and reported to county court
Wallace Rayburn Com. Co	30th and Fairmount Ave., Kansas City	"	17	"	" "	Quarantined and reported to county court
Geo. Wilkinson	3851 Michigan Ave., Kansas City	"	17	"	Suspected "	Quarantined
Mr. Alport	1729 Grand Ave., Kan. City.		27	"	Pharyngitis	
F. C. Conn	1300 Michigan Ave., Kansas City		24	"	Chronic glanders	Quarantined and reported to county court
Dr. Timothy Riley	3931 Main St., Kansas City		29	"	" "	Quarantined and reported to county court
W. F. Pyles	1508 Park Ave., "		28	"	" "	Quarantined and reported to county court
S. H. Wilkinson			May 3	"	" "	Quarantined and reported to county court
Will Hunter	1514 Grand Ave., Kan. City	Owner	5	"	" "	Quarantined and reported to county court

Henry Hunt	1619 Grand Av.,	"			13	"	" "	Quarantined and reported to county court
J. R. Hammond	2001 E. 18th St.,	"			17	"	" "	Quarantined and reported to county court
H. Yost	1815 Troost Av.,	"	Owner		17	"	" "	Quarantined and reported to county court
Clay Auction Co	559 Walnut St.,	"			20	"	Suspected glanders	Mallein test
J. C. House	3419 Michigan Av.,	"			21	2 horses	Chronic glanders	Quarantined and reported to county court
Landis Livery	4th & Wyandotte,	"			25	1 horse	Suspected glanders	Quarantined to be given mallein test
J. R. Hammond	2001 E. 18th St.,	"			25	"	Chronic glanders	Quarantined and reported to county court
Ira. Barnard	2609 W. Prospect Pl.,	"			26	"	" "	Quarantined and reported to county court
Wm. Shipley	Cor. Mo. & Grand Av.,	"			26	"	Glanders	Destroyed
(Unknown)	Kansas City Stock Yards				27	"	Nasal catarrah	
H. J. Walters	2204 Charlotte St., Kan. City				28	"	Chronic glanders	Mallein test; reported to county court
T. W. Sampsell	2949 Jackson Av.,	"	Dr. Yost	Dec.	6	"	" "	Quarantined and reported to county court
J. C. House	3419 Michigan Av.,	"			9	2 horses	" "	Quarantined and reported to county court
D. E. Kettering	3609 Independ'ce Av.,	"			10	1 horse	Suspected glanders	Quarantined to be tested
H. T. Emanuelson	4308 Madison Av.,	"			11	"	Chronic glanders	Quarantined and reported to county court
D. E. Kettering	3609 Independ'ce Av.,	"			14	"	" "	Quarantined and reported to county court
J. C. House	3419 Michigan Av.,	"			19	3 horses	" "	Quarantined and reported to county court

ANNUAL REPORT OF DR. R. C. MOORE, DEPUTY STATE VETERINARIAN, FOR YEAR, DECEMBER 19, 1904, TO DECEMBER 19, 1905—Continued.

Owner.	Postoffice.	How called.	Date.	Kind of stock.	Disease.	How disposed of.
Kerr & Webb and Mary and Ben Webb	Independence, Mo. Buckner, Mo.		8	horses	Mange	Released from quarantine
W. A. Disbrow	400 Delaw're St., Kansas City	Owner	9	1 horse	Chronic glanders	Destroyed
Depot Carriage & B. Co.	4th & Wyandotte, "	"	9	1 "	" "	"
Peter Klump	1213 Troost Av., "	"	10	1 "	" "	Quarantined and reported to county court
Mrs. Mary Webb	Buckner, Mo.		10	2 horses	Mange	
Peter Michaels	East Bottoms, Kansas City	Owner	11	1 horse	Exposed to glanders	Mallein test; quarantined
J. E. Sprague	215 Grand Av., "	"	15	1 "	Chronic glanders	Quarantined and reported to county court
Sam Davis	1336 East 15th St., "	"	15	1 "	" "	Quarantined and reported to county court
Mr. Kirby	Grand and Mo. Avs., "	"	16	1 "	" "	Destroyed
J. H. Leonard	19th and Tracy, "	"	18	1 "	Legs swollen from blistering	
Herman Moas	1910 Grand Av., "	"	21	1 "	Chronic glanders	Quarantined and reported to county court
O. C. Conley	523 Chestnut Av., "	"	21	1 "	" "	Quarantined and reported to county court
	1038 East 5th St., "	Humane officer.	22	1 "	Legs swollen from injury	
T. S. Stone	2224 Michigan Av., "	Owner	25	1 "	Chronic glanders	Quarantined and reported to county court
B. F. Anderson	1519 Virginia Av., "	"	26	1 "	" "	Quarantined and reported to county court
N. Harris	Blue Springs, Mo.	Dr. M. A. Peck.	27	1 "	" "	Destroyed
	Kansas City, Mo.	Humane officer.	1905 Sept. 9	1 horse	Mechanical pheumonia	
Max Studna	609 E. Mo. Av., Kansas City	S. R. Ingram	29	"	Purpura hemorrhagica.	
Admiral Hay Press Co.	8th & Mulberry, "	Owner	30	"	Chronic glanders	Quarantined and reported to county court
Barr-Duback Lumber Co	1900 Campbell St., "	"	Oct. 1	"	" "	Quarantined and reported to county court
Sam Studna	533 Cherry St., "	"	2	"	Glanders	Quarantined and reported to county court
Henry Deulsck	627 Holmes St., "	"	2	"	Chronic glanders	Destroyed
Wm. Williams	Liberty, Mo.	Dr. Luckey	8	Sheep	Injured by dip	
W. H. Denman	1028 Va. Av., Kansas City	Owner	12	1 horse	Chronic glanders	Quarantined and reported to county court
Dickey Clay Mfg. Co.	East Bottoms, "	"	12	"	Septic foot	
Ad. Hartman	1618 Grand Av., "	Dr. Hadley	13	"	Chronic glanders	Quarantined and reported to county court
J. L. Wilgus	4000 Hamilton Av., "	Owner	25	"	" "	Quarantined and reported to county court
	1810 Charlotte, "		Nov. 12	"	" "	Destroyed
Ed. Klein	1029 E. 9th St., "		13	"	" "	Quarantined and reported to county court

Henry Hunt	1619 Grand Av.,	"			13	"	" "	Quarantined and reported to county court
J. R. Hammond	2001 E. 18th St.,	"			17	"	" "	Quarantined and reported to county court
H. Yost	1815 Troost Av.,	"	Owner		17	"	" "	Quarantined and reported to county court
Clay Auction Co.	559 Walnut St.,	"			20	"	Suspected glanders	Mallein test
J. C. House	3419 Michigan Av.,	"			21	2 horses	Chronic glanders	Quarantined and reported to county court
Landis Livery	4th & Wyandotte,	"			25	1 horse	Suspected glanders	Quarantined to be given mallein test
J. R. Hammond	2001 E. 18th St.,	"			25	"	Chronic glanders	Quarantined and reported to county court
Ira. Barnard	2609 W. Prospect Pl.,	"			26	"	" "	Quarantined and reported to county court
Wm. Shipley	Cor. Mo. & Grand Av.,	"			26	"	Glanders	Destroyed
(Unknown)	Kansas City Stock Yards				27	"	Nasal catarrah	
H. J. Walters	2204 Charlotte St., Kan. City				28	"	Chronic glanders	Mallein test; reported to county court
T. W. Sampsell	2949 Jackson Av.,	"	Dr. Yost	Dec.	6	"	" "	Quarantined and reported to county court
J. C. House	3419 Michigan Av.,	"			9	2 horses	" "	Quarantined and reported to county court
D. E. Kettering	3609 Independ'ce Av.,	"			10	1 horse	Suspected glanders	Quarantined to be tested
H. T. Emanuelson	4308 Madison Av.,	"			11	"	Chronic glanders	Quarantined and reported to county court
D. E. Kettering	3609 Independ'ce Av.,	"			14	"	" "	Quarantined and reported to county court
J. C. House	3419 Michigan Av.,	"			19	3 horses	" "	Quarantined and reported to county court

ANNUAL REPORT OF DR. H. V. GOODE, DEPUTY STATE VETERINARIAN, FOR YEAR, DECEMBER 19, 1904, TO DECEMBER 19, 1905.

Owner.	Postoffice.	How called.	Date.	Kind of stock.	Disease.	How disposed of.
			1905.			
Jno. Lynch and J. W. Scammerhorn	Grant City	Board of Agri.	March 3	Horses	Scabies	Quarantined
Gus Peterson	"	" "	14	"	"	"
M. A. Marshall	Winthrop	" "	May 10	Horse	"	"
J. M. Edson	New Hampton	" "	23	7 cattle	Foot & mouth disease	2 destroyed, rest treated
G. A. Laur	Westboro	State Veterin'n.	June 29	43 "	Scabies	Quarantined
J. S. Sillers	Fairfax	" "	Aug. 14	40 "	"	"
J. A. Venable	Gower	Tele'm, Geo. B. Ellis	Sept. 2	12 steers		Dead
J. H. Wylie and W. F. Wilkerson	Stewartsville	State Veterin'n.	19	147 sheep	Scabies	Dipped
E. A. Betts	East Atchison	Tele'm Geo. B. Ellis	Nov. 19	6 horses	Glanders	Three did not re-act. Quarantined and court notified.
" "	" "	Re-test	Dec. 5	3 horses	Supposed glanders	Found free from glanders

ANNUAL REPORT OF DR. J. HARVEY SLATER, DEPUTY STATE VETERINARIAN, FOR YEAR DECEMBER 19, 1904, TO DECEMBER 19, 1905.

Owner.	Postoffice.	How called.	Date.	Kind of stock.	Disease.	How disposed of.
W. F. Botts	Carrollton	Board of Agri.	March 4	1 filly	Acute glanders	Quarantined
G. E. Shirky	Norborne	Telegram	Aug. 21	2 heifers	Dead on arrival	Burned carcasses
Wm. B. Brooks	Bogard	Geo. B. Ellis	31	1 filly	Strangles	

ANNUAL REPORT OF DR. T. E. WHITE, DEPUTY STATE VETERINARIAN, FOR YEAR, DECEMBER 19, 1904, TO DECEMBER 19, 1905.

Owner.	Postoffice.	How called.	Date.	Kind of stock.	Disease.	How disposed of.
			1905.			
Gunn & Mayfield	Otterville	Dr. Luckey	Jan. 5	Sheep	Scabies	Quarantined
Samuel Burdick, C. Y. McDonald, Jenet Kelley	Clinton	Secretary Board of Agriculture.	June 17	69 cattle from Texas escaped from car		Quarantined land cattle shipped
C. C. Dickinson, J. H. Kyle, W. F. Boyd	Clinton	Letter and telephone	20	Texas cattle escaped from car.		Quarantined land

ANNUAL REPORT OF DR. W. F. BERRY, DEPUTY STATE VETERINARIAN, FOR YEAR, DECEMBER 19, 1904, TO DECEMBER 19, 1905.

Owner.	Postoffice.	How called.	Date.	Kind of stock.	Disease.	How disposed of.
Art Browning	Verona	Wire	Feb. 26	Cattle		Removal from stock field
H. Smith	Fidelity	Letter	March 1	1 horse	Acute glanders	Dead.
Jos. Pace	Milo	"	7	Cattle		
Wm. Kruse	Neosho	Wire	April 24	Horse and mule	Rabies	Dead.
Fred. Poggemeyer	Freistatt	Letter Sec'y B'd of Agriculture	June 3	Horse	Chronic glanders	Quarantined and reported to county court
	Seneca	Wire, I. H. Collier	July 8	Cattle	Texas fever	Quarantined and reported to county court
C. E. Horton	Hume	Wire, Geo. B. Ellis	Sept. 1	"	Plant poisoning	Change of pasture

ANNUAL REPORT OF DR. HORACE BRADLEY, DEPUTY STATE VETERINARIAN, FOR YEAR, DECEMBER 19, 1904, TO DECEMBER 19, 1905.

Owner.	Postoffice.	How called.	Date.	Kind of stock.	Disease.	How disposed of.
Dick Givens	Windsor	Owner	1905 Jan. 9	1 horse	Chronic farcy	Quarantined
J. T. Hughes	Blairstown	Board of Agri.	Feb. 15	Sheep	Intestinal nodular	Prescribed turpentine
O. D. Phipps	"	" "	15	"	" "	" "
O. L. Goodman	Pleasant Hill	" "	Mch. 2	Cow	Tuberculosis	Advised tuberculin test
C. A. Lawson	Clinton	" "	26	Horse	Purpura hemorrhagica.	
R. W. Cordes	West Line	" "	Apr. 23	"	Bad teeth	Dead
Earl Parker	Pleasant Hill	'Phone call—Dr. Fort	June 3	1 horse	Chronic farcy	Quarantined and reported to county court
A. G. Foster	Windsor	Owner	Aug. 1	"	Chronic glanders	Quarantined and reported to county court
J. H. Odle	Brownington	Sec. Bd. of Agri.	3	2 horses	" "	Quarantined and reported to county court
	Green Ridge	Citizens of Green Ridge	4	20 cows	Texas fever	Quarantined and reported to county court
A. J. Calvert	"	Owner and citizens of Green Ridge	2	Cows	" "	Quarantined and reported to county court
Oscar Ward	Blairstown	Sec. Bd. of Agri.	Nov. 25	1 horse	Influenza	Treated
H. W. Rhodes	Schell City	" " "	Dec. 1	2 horses, 1 mule	Mange	2 dead
Geo. Henselman	Appleton City	State Vetern'n.	18	150 cattle	Scab.	Cattle dipped, yards disinfected

ANNUAL REPORT OF DR. S. SHELDON, DEPUTY STATE VETERINARIAN, FOR YEAR, DECEMBER 19, 1904, TO DECEMBER 19, 1905.

Owner.	Postoffice.	How called.	Date.	Kind of stock.	Disease.	How disposed of.
Geo. W. Nigh	Spickards	Letter, Geo. B. Ellis	March 7	Cattle	Ergot poisoning	Hypo-sulphate of soda
W. E. Keown	Gilman	Letter, Geo. B. Ellis	30	Mules	Cyst in the nose	Creolin solution
Messrs. Kauffman, Smith and S. Williams	Princeton	Dr. Luckey	Oct. 7	Sheep	Scabies	Dipped

ANNUAL REPORT OF DR. CHARLES DOERRIE, DEPUTY STATE VETERINARIAN, FOR YEAR, DECEMBER 19, 1904, TO DECEMBER 19, 1905.

Owner.	Postoffice.	How called.	Date.	Kind of stock.	Disease.	How disposed of.
	Boonville	Telephone, wr'k on M., K. & T., cattle escaped	Aug. 26	Cattle	2—Texas fever	Two killed and 26 quarantined
W. R. Million	Boonville		26	Calf	"	Quarantined
Col. T. A. Johnson	"		26	Cows	"	"
Henry Stickman	"		26	Cow	"	"
Sam Ravenel	Old Franklin		27	Cows	"	"
Leopold Fessler	Boonville		27	"	"	"
Frank Berend	"		27	"	"	"
George J. Hain	"		27	"	"	"
John Cosgrove, C. L. George, C. A. Bradner, Peter Trester	Boonville		27	"	"	"
V. C. Drennen	"		31			Quarantined land to prevent spread of Texas fever
Chas. Johnson	"		28	Cow	Texas fever	Quarantined
Herman Klusmeyer, A. A. Howard, Mrs. Johanna Sanders, W. M. Ells, Gus Anderson, Wm. Burger, Mathilda Shepherd.	Boonville		29			Quarantined land to prevent spread of Texas fever

ANNUAL REPORT OF DR. E. M. HENDY, DEPUTY STATE VETERINARIAN, FOR YEAR, DECEMBER 19, 1904, TO DECEMBER 19, 1905.

Owner.	Postoffice.	How called.	Date.	Kind of stock.	Disease.	How disposed of.
Wm. Goodrich	Tuscumbia	Wire	1905. March 27	Cattle	Blackleg	

ANNUAL REPORT OF DR. R. P. POAGE, DEPUTY STATE VETERINARIAN, FOR YEAR, DECEMBER 19, 1904, TO DECEMBER 19, 1905.

Owner.	Postoffice.	How called.	Date.	Kind of stock.	Disease.	How disposed of.
J. E. Walkup	Armstrong	Telegram	1904. Dec. 29	Steers	Poisoning	Dead
Wm. Schnaufer	Bethel	Dr. Luckey	1905. Jan. 6	Sheep	Scabies	Dipped

ANNUAL REPORT OF DR. J. W. CONNAWAY, DEPUTY STATE VETERINARIAN, FOR YEAR, DECEMBER 19, 1904, TO DECEMBER 19, 1905.

Owner.	Postoffice.	How called.	Date.	Kind of stock.	Disease.	How disposed of.
Peter Rowland	Macon	Petition	1905. Oct. 29	Cattle	Rabies or cerebro spinal meningitis	Dead

ANNUAL REPORT OF DR. L. D. BROWN, DEPUTY STATE VETERINARIAN, FOR YEAR, DECEMBER 19, 1904, TO DECEMBER 19, 1905.

Owner.	Postoffice.	How called.	Date.	Kind of stock.	Disease.	How disposed of.
Thos. Kensella	Wheeling	Dr. Jas. Bennett	1905. Oct. 9	Horse	Glanders	2 destroyed, others quarantined

ANNUAL REPORT OF DR. H. H. WOLF, DEPUTY STATE VETERINARIAN, FOR YEAR, DECEMBER 19, 1904, TO DECEMBER 19, 1905.

Owner.	Postoffice.	How called.	Date.	Kind of stock.	Disease.	How disposed of.
A. W. Collison	Maitland	Dr. Luckey	1905. Feb. 23	Sheep	Scabies	Quarantined

ANNUAL REPORT OF DR. H. F. BOETTNER, DEPUTY STATE VETERINARIAN, FOR YEAR, DECEMBER 19, 1904, TO DECEMBER 19, 1905.

Owner.	Postoffice.	How called.	Date.	Kind of stock.	Disease.	How disposed of.
D. C. Smith	Ellington	Petition	1905. Oct. 31	Horse	Abscess	Treated

ANNUAL REPORT OF DR. R. B. LOVE, DEPUTY STATE VETERINARIAN, FOR YEAR, DECEMBER 19, 1904, TO DECEMBER 19, 1905.

Owner.	Postoffice.	How called.	Date.	Kind of stock.	Disease.	How disposed of.
J. R. Deputy	Brookline		1904. Dec. 29	1 horse	Chronic glanders	Quarantined
Numerous	Lebanon	State Vetern'n	1905. Jan. 26	Sheep	Scabies	"
A. Johnson, Tom Robertson and others	Ozark	Petition	June 19	Horses, mules	Mange	"
W. A. Glassy	Cuba	Sec'y B'd Agri.	July 12	Cattle	Actinomycosis and laryngitis	"
L. C. Delph	Conway	Dr. Luckey	17	Sheep	Scabies	"
Dan Huckins	Tiff City	Wire	Oct. 26	Mare	Ulcerated tooth	Extracted

ANNUAL REPORT OF DR. JAS. CULLISON, DEPUTY STATE VETERINARIAN, FOR YEAR, DECEMBER 19, 1904, TO DECEMBER 19, 1905.

Owner.	Postoffice.	How called.	Date.	Kind of stock.	Disease.	How disposed of.
Thos. McElyea	Campbell	Telegram, Geo. B. Ellis	April 28	2 horses	Glanders	Quarantined
Doniphan Lumber Co.	Doniphan	Letter	July 12	1 horse	"	Dead
M. P. Holmes	Piedmont	Telegram	Aug. 1	Cattle	Haems-albuminuria	Quarantined
Squire Collins	Doniphan	Letter	31	1 horse	Chronic glanders	Dead
C. P. Hawkins	Kennett	Telegram	Oct. 9	Cattle	Texas fever	"
Doniphan Lumber Co.	Doniphan	Return visit	18	Horse		Raised quarantine
McFadden & Mathews	Oran	Telegram	Nov. 3	"		Dead before arrival
Pioneer Cooperage Co.	Lutesville	"	14	Mules		" " "

ANNUAL REPORT OF DR. F. W. O'BRIEN, DEPUTY STATE VETERINARIAN, FOR YEAR, DECEMBER 19, 1904, TO DECEMBER 19, 1905.

Owner.	Postoffice.	How called.	Date.	Kind of stock.	Disease.	How disposed of.
			1904			
M. Ellmore	Bellflower	Letter, State Bd. of Agriculture	Dec. 19	2 horses	Glanders	Reported to county court.
			1905			
C. O. Crane	Palmyra	Letter, Dr. Luckey	Feb. 1	Sheep	Scabies	Quarantined
Judge McCutheon	Monticello		28	"	"	Quarantined and reported to county court.
Johnson Morrow	Macon City	Letter, Geo. B. Ellis	June 27	Cow	Tuberculosis	Destroyed
J. L. Wilson	Canton	Letter, Dr. Luckey	July 14	Sheep	Scabies	Quarantined
McNally & Arnold	Lewiston	Letter, Dr. Luckey	Aug. 1	"	"	

ANNUAL REPORT OF DR. STANLEY SMITH, DEPUTY STATE VETERINARIAN, FOR YEAR, DECEMBER 19, 1904, TO DECEMBER 19, 1905.

Owner.	Postoffice.	How called.	Date.	Kind of stock.	Disease.	How disposed of.
A. S. J. Harrison	Mexico	Dr. Luckey	Jan. 28	Sheep	Scabies	Shipped to St. Louis market
Joe Mason	Moberly	"	30	"	"	" "
Isaac J. Stone	Dripping Springs		May 17	Horses	"	Quarantined
Dan Foley	"		22	Horses and mules.	"	"
Mack Stone	Perche		22	1 mule	"	"
M. E. Forbis	"		22	Horses and mules.	"	"
Dyer Pugh	Dripping Springs		22	2 horses	"	"
Bell Fenton	"		22	8 horses	"	"
Jonathan Cook	Columbia		29	1 mare	"	"
B. Diggs	"		29	2 horses	"	"
I. Stone, Bell Fenton, D. Pugh & Bell Forbis	Dripping Springs and Perche	Called to release from quarantine	June 26	Horses and mules.	"	
Marhall Forbis	Sturgeon	To release quarantined horses.	Aug. 17	Horses	"	
Thos. W. Herring	Martinsburg	Dr. Luckey	Nov. 21	Sheep	"	Quarantined

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